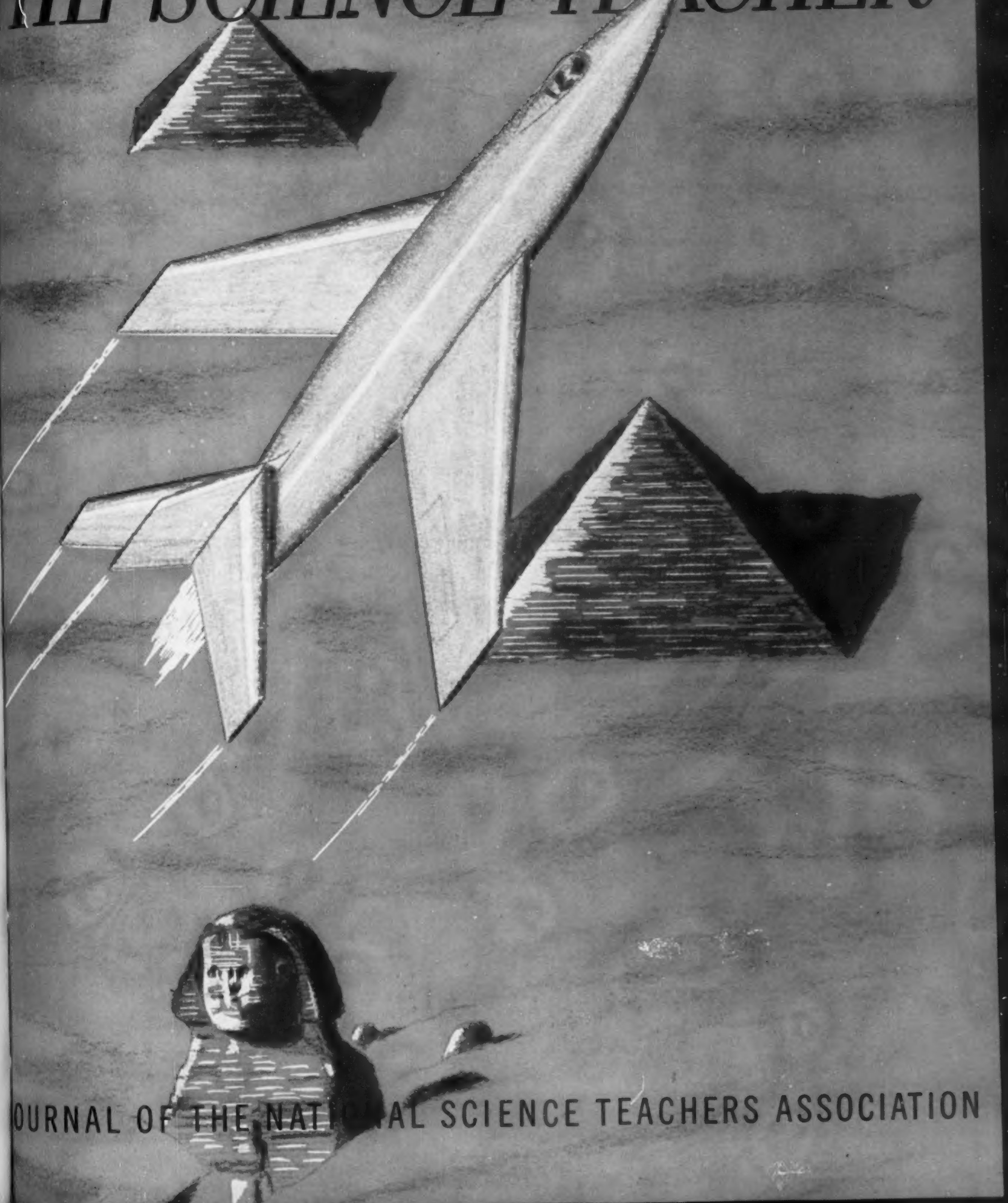
Vol. XXV, No. 5

SEPTEMBER 1958

THE SCIENCE TEACHER



JOURNAL OF THE NATIONAL SCIENCE TEACHERS ASSOCIATION

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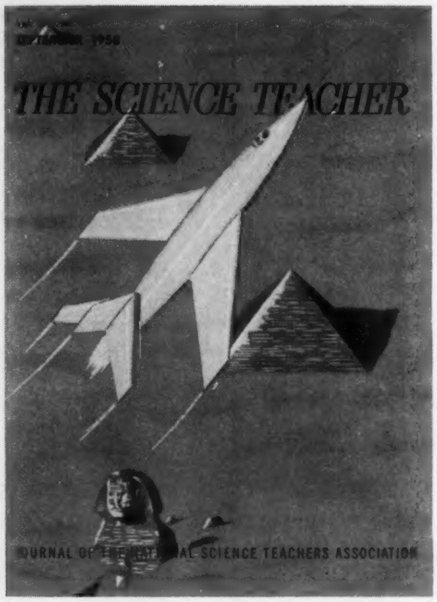

THIS MONTH'S COVER . . .

THIS MONTH'S COVER . . . Beyond the Desert was originated by our Associate Editor as a tribute to the science teacher whose task is to bridge the span of knowledge from past to present, from old to new, and from ancient thought to modern.

BUT THE QUEST—not in the greatness of material as the pyramids, or in the power of a rocket, but the greatness of research, effort, and dedication for a better world—beyond the desert and INTO THE FUTURE.

THE SCIENCE TEACHER

Articles published in THE SCIENCE TEACHER are the expressions of the writers. They do not represent the policy of the Association or the Magazine Advisory Board.

The National Science Teachers Association is a department of the National Education Association and an affiliate of the American Association for the Advancement of Science. Established in 1895 as the NEA Department of Science Instruction and later expanded as the American Council of Science Teachers, it merged with the American Science Teachers Association and reorganized in 1944 to form the present Association.

Vol. XXV, No. 5 — September 1958

Editor's Column

With the beginning of the school year 1958-59, some reflections in this column on NSTA seem appropriate. On the verge of almost 15 years of operation (next July) and as a part of NEA headquarters staff for 10 years (on September 1), the Association has developed a professional maturity which all members may share with pride.

Basic to the total endeavor is membership. During 1957-58, there was a 19 per cent gain despite an increase of 50 per cent in dues. Total members and subscribers last May 31 were 12,600 (not including nearly 20,000 student subscribers to *Tomorrow's Scientists*). There is reason to believe we may reach 15,000 by next May 31.

This journal is our chief means of communication. *TST* circulation is well over 13,000 this issue, and our readership must be twice this figure. We are told that the quality of content continues to improve. We hope so. We are sure that its physical size is growing. Beginning with this issue, *The Science Teacher* moves to 64 pages per issue, 512 pages per volume—an increase of 33⅓ per cent over our standard 48 pages per issue of the past five years.

The NSTA program of services and activities for this year calls for a budget of $341,000 and a staff of 15 full-time persons.

The consulting role of your officers and staff assures a "voice for science teachers" in numerous undertakings of other professional societies, government agencies, private groups, etc. Not many days go by in headquarters without half a dozen telephone inquiries, and 15 to 20 letters requesting information on enrollment statistics, courses of study, curriculum developments, etc. We feel somewhat confident that we are giving satisfactory answers to most of these.

But we know we cannot become self-satisfied and complacent. Many areas need strengthening, and we're not yet ready to operate on a plateau. There are many possibilities for growth and improvement. Your help and advice are needed on such questions as these:

1. Should NSTA undertake to develop Future Scientists of America student groups?
2. Should NSTA seek to formulate "a code of professional performance" for science teachers?
3. How can NSTA help strengthen state organizations of science teachers, and strengthen working relations with our affiliated groups?
4. In what ways can we involve more college-level scientists in NSTA programs for all educational levels?
5. Which areas of communication and public relations need expansion?
6. Do currently established NSTA committees meet our needs, or should others undertake new endeavors in special fields, or in cooperation with other groups having common interests with NSTA?
7. What special publication needs are anticipated for instructional purposes, and the emerging curriculum?

Let our officers and staff hear from you on these questions and others which you may have.

Robert H. Carleton

THE SCIENCE TEACHER

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OFFICERS OF THE ASSOCIATION

MEMBERSHIP

The membership year coincides with the calendar year. New entries during the fall months extend through the following calendar year.

Regular Membership	$ 6.00
Sustaining Membership*	10.00
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Life Membership* — Payable in ten annual installments; $150.00 if paid in three years or less.	175.00
Library Subscription*	8.00

* Includes the *Elementary School Science Bulletin* and *Tomorrow's Scientists*.

Readers' Column

Reactions to NSTA's Debt Reduction and Reserve Development Plan:

"It is easy to find many ways of spending $2.00 these days but it is not easy to find a new and more worthwhile cause."

"I have been so pleased with the service received from your organization that I am glad to send a check for four dollars."

"Why don't you increase the dues to pay the expenses?"

"I wish I could erase my debts and establish budgets this easily. I think more effort on the part of the Association would have been in place. However, if now we are adult and we can live within our budget, O. K. Here's $15.00."

"NSTA is well worth the money. If necessary, an increase in dues would get no objections from me."

I expect you are much too busy to read letters from individual science teachers, but I feel you should know that I consider my membership in the NSTA the best investment I've ever made, and I belong to seven other professional organizations.

My attendance at the FSAF Westvaco, University of Maryland Conference last summer helped me guide six of my seniors into higher education this year. All were on scholarships—one in biochemistry, two in nursing, two in teaching, and one in pre-law. Two others went to college; all were from our graduating class numbering 35.

William W. Cash, Jr.
Director, Science Dept.
Eagle Rock High School
Eagle Rock, Virginia

Three cheers for an excellent May 1958 issue of *The Science Teacher*. Nothing pleases me more than to get fresh ideas for experiments and classroom ideas. I particularly liked the article "Points and Counterpoints in Teaching Science." I think though that I would be more specific as to what is recommended for teaching at the various grade levels.

Your magazine gets better with each issue, keep up the good work. The whole May magazine was most professional. I am going to use some of the projects for my students next year. I will send my renewal for membership soon, and next winter, I will have another entry for STAR.

Stanley R. Breckner
Albert Lea
Minnesota

It was a pleasure to get your letter and to learn that the *School Science Review* is read and appreciated by Science Teachers in U. S. A. I do also receive your own journal *The Science Teacher* and have often noted articles and experiments which have been useful to us.

May I take this opportunity of sending to you and to your fellow teachers of Science in U. S. A. the most cordial greetings of *The Science Masters' Association* of Great Britain.

Robert H. Dyball
Editor, The School Science Review
Brentwood, Essex, England

The March 1958 issue of TST has a fine bibliography following the article by Sam S. Blanc, "Guideposts in Science Education," page 112.

Such a bibliography should however include the Review of Educational Research, V. 27, No. 4, October 1957, entitled "The Natural Sciences and Mathematics," published by AERA, an NEA affiliate.

Marvin Paul
El Cajon Valley High School
El Cajon, California

Please send me a set of "Elementary School Science Bulletin" for the school year 1957-58. I have been giving mine to our Superintendent of Schools and would like to replenish my files.

These bulletins are "worth their weight in gold." One can get wonderful ideas from them. Thank you.

John S. Petix
Hackensack High School
Hackensack, New Jersey

I certainly enjoyed being with NSTA members at the Bowling Green State University Conference of NEA's Commission on Teacher Education and Professional Standards. Next to the Denver convention in March, it was one of the most enlightening and enjoyable experiences in my professional career.

I can't tell you how much I value the professional lift NSTA has given me over the years.

Alton Yarian
General Science Teacher
Emerson Junior High School
Lakewood, Ohio

Based on an address at the Sixth National Convention of NSTA, Denver, Colorado, March 28, 1958.

By DUANE H. D. ROLLER

University of Oklahoma, Norman

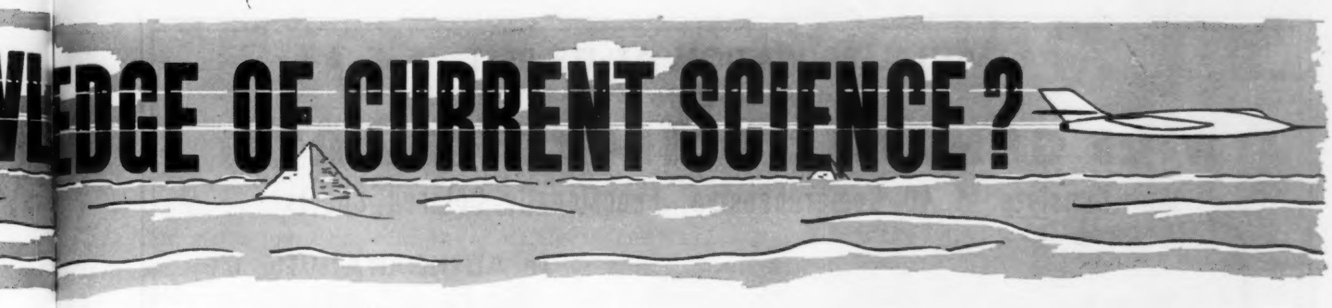
ANALYSIS of the important question *How can we use current science knowledge?* is advisable in evaluating science education today. To begin, reference must be made to the use of our knowledge of current science for purposes of general education—in primary or secondary teaching, or in teaching a single science course to non-science majors in college. How might the use of current science be of value in such teaching?

First, let us consider some illustrative examples of current science. One particularly engaging aspect of current science is the study of nucleic acids and their relation to genes and the synthesis of proteins. Although a stimulating topic, one cannot fully discuss it without first supplying the student with detailed background knowledge—for instance, knowledge of the theory of organic molecules, which requires understanding many other topics. How can one use this bit of current science in science teaching? The answer is fairly straightforward: one CAN NOT. The students we are talking about lack the necessary background.

Another example is the problem of nuclear-binding forces. During the last 300 years physicists have, beginning with the Newtonian gravitational theory, worked their way to an elaborate theory of atomic structure. They have merged a complicated mathematical, electro-magnetic theory of light with quantum and relativistic mechanics, to obtain a general theory that is concerned first with a complex that we might call the inverse-square forces. Then using the sophisticated mathematical tools thus developed, they have attacked the nuclear-binding problem, finding for example, that types of force exist that are completely foreign to our common-sense notions of force. This then is a threshold of physics today: here is current science. How can one use it for purposes of general education? You CAN NOT except perhaps in some special class, such as in a twelfth-grade group at the end of a year-course in physics designed especially for competent and earnest students. That is how it looks to me. Any attempt to introduce current science in a casual way will not only fail, but almost surely will foster misunderstandings. Furthermore, who is to teach the teacher? Current scientific knowledge is always changing, and none of us can hope to stay at the forefront in many different fields.

Perhaps you may say I am choosing my examples badly. One would expect examples from current physics to be complex and difficult—after all, modern physics has been developing in an unbroken sequence for 700 years. And modern chemistry has had a vigorous history for the last 300 years. Let us choose a newer and less developed field. For example, genetics is at most less than a century old. Can we teach current genetics? My geneticist friends complain bitterly that even college majors in zoology find that genetics is particularly difficult because of the enormous amount of mathematical background that is lacking.

From another point of view, one may well say: "By the term 'current science' I don't mean biochemistry, nuclear physics, and genetics. Of course, they *are* current and they *are* science, but obviously they are too difficult. I mean the simpler areas or topics of current science, such as rockets and steam engines, agricultural developments, television, automobiles, and oil refineries." As a matter of fact, I suspect that this is what really was implied in the question. It was intended to mean: "How can we use Sputnik, and the Salk vaccine in improving the teaching of science?"



Before attempting to examine this interpretation of the question, I should like to turn for a moment to what may be a pressing prerequisite to the whole discussion: just what do we mean by the term *science*?

Man is concerned with natural phenomena for two reasons: he has an interest in understanding and explaining nature on the one hand, and an interest in controlling nature on the other. We might contrast these as intellectual and practical interests.

Early Stewards of Science

The practical interest came first. Indeed man has advanced by his ingenuity to devise tools and methods which increase his control over nature. His early history is characterized by the inestimable value of his inventions, such as the ax, the grindstone, the plow, and the wheel and cart. Later came his construction feats, such as the pyramids of Egypt, and the richly decorated temples. This practical interest, this desire to control by inventing and building, has led to some spectacular achievements. The great pyramid of Cheops is still one of the largest man-made structures in the world and reflects the extraordinary genius of the engineers who built it. Similarly, Egyptian medical papyri from this era show us that the Egyptians were remarkably able in the field of surgery. But all of the Egyptian concern with natural phenomena was in the area of control, not in the area of understanding basic science. One can build pyramids without a knowledge of physics or mathematics—and the Egyptians did. One can trepan a skull without knowing any biology—the Egyptians did.

In brief, the early history of civilizations make it quite clear that the control of nature is possible on a large scale without any prior or even concurrent attempt to understand natural phenomena. The Egyptians were utterly disinterested in explaining natural phenomena. Moreover, and rather curiously, there has been no close relationship, until recent times, between man's practical aim of controlling nature and his intellectual aim of explaining nature. Contrary to fable, the pyramids were built by a culture that possessed only a few geometric notions, and whose knowledge of mathematics in general was primitive.

The Greek culture, in contrast, became obsessed with the search for explanation, beginning in about 600 B. C. By that time Greek minds had formulated the fundamental postulate of those who seek explanation: there is order and unity in nature. Within a period of a few hundred years the Greeks had formulated every major problem in science and every major mode of attack on those problems. The role of classical Greek Antiquity in man's search for explanation is dramatized by the fact that for two thousand years every culture which has contributed to an understanding of nature has known of and built upon the foundations established by the Greeks.

Here then we find two distinct activities of mankind: first, the attempt to control nature that is indeed a distinguishing characteristic of man; and second, the attempt to explain natural phenomena that is found only on a large scale among the Greeks of classical antiquity and their intellectual descendants. The most interesting thing about these two activities is their diversity. We thus distinguish them, in our language, with different terms, and the most reasonable distinction is obtained by calling man's search for explanation of natural phenomena SCIENCE, and man's attempt to control nature TECHNOLOGY. Let me illustrate their separate character with some historical examples.

Science, the search for explanation, was an activity that the Romans found totally uninteresting. Thus, although the Romans borrowed construction techniques from the Greeks, although the Romans built marvelous roads and great aqueducts, they neither absorbed Greek scientific knowledge nor contributed to the search for explanation. As a result, the Latin world that we call Western Christendom was ignorant of the scientific methods used by the Greeks.

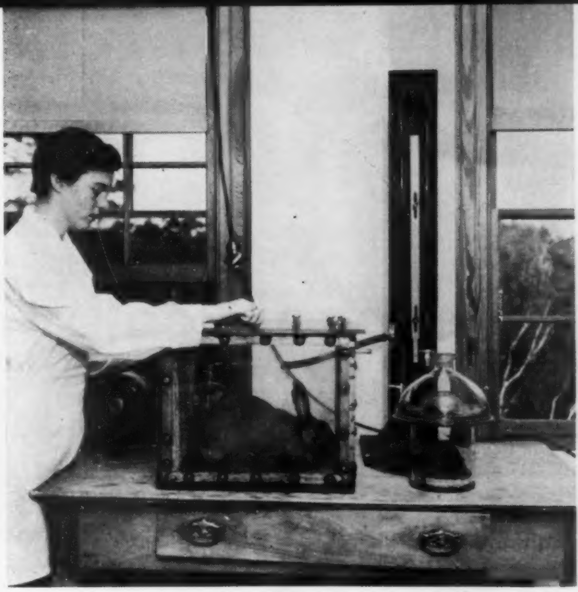
No more striking example of the difference between science and technology can be found than the situation in the West following the decay of the Roman Empire. There was no science in the West, but following a brief interim period after the fall of Rome, the West began to press forward in technology again in the age-old drive to control nature for man's use. Some of the most significant technological advances in man's history occurred in these so-called Dark Ages, the millennium following the fall of Rome. It was an unknown ninth-century genius who invented the horse collar. The Romans had had horses, to be sure, but they lacked the horse collar. They attached the chariot or what-have-you to a rope tied around the horse's neck or his tail. Under these circumstances a horse could only do four times as much work as a slave, and it ate four times as much as a slave. But when equipped with a collar, a horse could do ten times as much work as a man.

Another invention of the ninth or tenth century was the nailed horseshoe; still another, the heavy Anglo-Saxon plow. Together, these remarkable technological advances vastly increased the productivity of agriculture.

Early Medieval Europe also developed an elaborate metals technology. Very complex mining machinery, often driven by horses, made possible the improved productivity of mines. More iron ore meant more iron, and hence more horseshoes and more plows to produce more grain to feed more horses to work in the fields or in the mines.

Our present knowledge of Medieval technology, which incidentally is relatively new, could be endlessly illustrated with a vast variety of such examples. The point to be made here is that this remarkable technology was an activity entirely unrelated to science. Man was greatly increasing his control over nature without carrying on any attempt to explain nature. The European scholar of this period had no access to Greek science, which had not yet become available in the West, and he was ignorant of the methodology of science. Even the most brilliant minds in Europe were helpless in the area of science. Yet this era was developing a technology that was to result in such magnificent achievements as the great Gothic cathedrals, and movable type for printing.

In the twelfth century, the West began to acquire Greek manuscripts and hence knowledge of Greek science. This new knowledge had a profound effect on the West, and part of this effect was the beginning of modern science, which has continued in unbroken sequence to the present day. Yet modern science developed quite independently of technology, and technology was quite unrelated to science. In the sixteenth and seventeenth centuries, the era of Copernicus and Vesalius, of Kepler and Gilbert, of Galileo and Newton, of Descartes and Leibnitz, of Huygens and Boyle, technology and science rushed forward along their separate paths, without any interaction. And this pattern, already two thousand years old, continued into the eighteenth century.



Science

For instance, one of the notable eighteenth-century advances in physics was the development of electrical theory. The work of Hauksbee, Gray, and Dufay culminated in the brilliant principle of conservation of electric charge, formulated by Benjamin Franklin. Yet when Franklin was asked, "What good is electricity?" he parried with a counter-question: "What good is a new-born baby?" The candid answer would have been, "As far as I know, electricity has no practical applications."

Seventeenth-century scientists such as Borelli and Descartes had applied a Greek idea with a new twist to the study of life. This idea, ***mechanism,*** was extended in the eighteenth century by such scientists as Hales and Lamarck to supply the beginnings of the theory of organic evolution. Yet this work contributed nothing to the technological problems of plant and animal breeding. In brief, up to about 1800, one can see two separate activities of mankind: the search for control of natural phenomena, which I think should be called ***technology*** and the search for explanation of natural phenomena, which I prefer to call *science*.

These continue their separate ways to the present time, but from the beginning of the nineteenth century a significant link begins to develop between them. Here, for the first time in the history of mankind, the explanations of natural phenomena

that the scientists are providing turn out to be useful to the engineers and technologists. For example, the scientific work of Franklin, Coulomb, and others was extended by the scientist Michael Faraday into a general theory of electro-magnetism which, in the hands of such technologists and inventors as Siemens and Edison became an electric power industry; James Clerk Maxwell's continuance of this path of development in physics provided information which such technologists as Marconi and Fleming used to produce radio.

Perhaps the technologist has always played a far more important role in our society than has the scientist. The reason for this is clear: the scientist is, in searching for explanation, really after the sort of emotional and intellectual satisfaction that he hopes to find by achieving understanding. Thus the scientist's goal is the inward reward of understanding, and this is of little interest to others, especially in a society that still exhibits or retains strong pioneer characteristics.

In contrast, the technologist's goal of controlling nature has repercussions throughout our daily lives too obvious to justify special comment.

But once technology becomes *applied* science, once science becomes an activity that produces knowledge of interest to the engineer, then science, the search for explanation, also becomes of interest to everyone, not really for itself, but because of what it can do for technology. Science remains, to be sure, an intellectual activity, a search for explanation, but the results of that search are bodies of knowledge that the technologist can use in his own search for control over nature. If one wants technology, one now wants science too, since it therefore aids technology.

Yet they remain very diverse activities. Science is an intellectual activity, technology a practical one; science deals chiefly with ideas, technology chiefly with things. And precisely because of these fundamental differences, different cultures react differently to science and to technology. For example, the Romans adopted Greek technology but not Greek science.

Now the American outlook is basically materialistic; we are more interested in things than in ideas. It has been suggested that this materialism may in part be a heritage of frontier days, when an axe, a handful of nails, or a gun seemed infinitely more important than, say, Plato's conception of reality. Perhaps so; whatever the reasons, we are indubitably materialistic. Only a strongly materialistic culture is likely to foster the far-too-common American attitude that teachers are failures because they earn so little money. Even within the teaching profession we tend to evaluate teachers in terms of things rather than in terms of their ability to teach and to inspire. We find ourselves uneasy when asked to evaluate the inspirational ability of a teacher; we would rather count his diplomas. As for the students, one counts credits acquired toward graduation.

Another example of our materialism is the way in which we have been teaching for half a century the fable that Galileo was a great scientist because he threw some rocks off the Tower of Pisa, and that Franklin was a great scientist because he invented the lightning rod.

One might suspect that a materialistically minded culture would, like the Romans, adopt technology but fail to foster, or even to comprehend, science. And this appears to be the case in the United States. A striking indication is how few really first-rate scientists we have produced per unit population.

Our culture is materialistic. But if it must be so labeled, this is not to condemn, but to describe it. If our interest primarily in technology rather than in science must be emphasized, this is to illuminate our present situation and not merely to criticize it. Yet we should be mature enough to face the facts.

Technology

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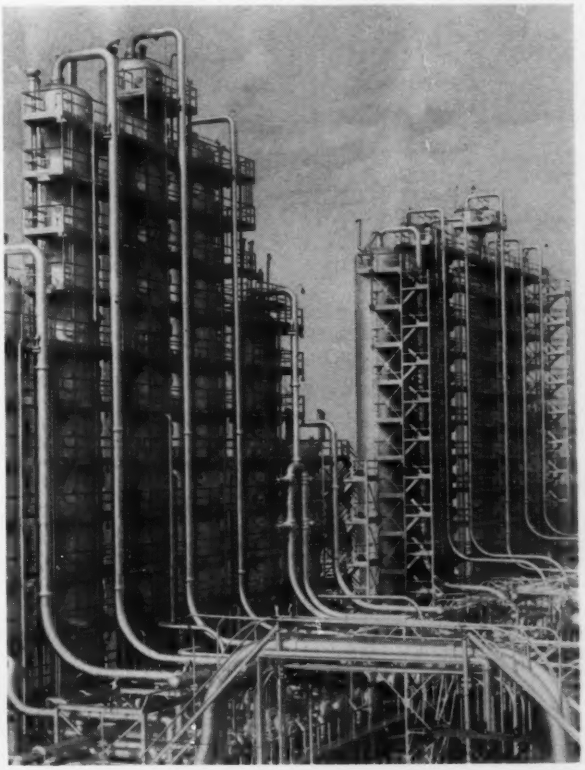

One is that technology is becoming increasingly more dependent on that intellectual activity called science. A second is that we live in a culture that does not easily understand intellectual activity, one that regards such activity with scorn, distaste, and perhaps even some fear.

The result is obvious. Considering the size of our population and the extent of our opportunities, we produce too little science in the United States, and what we do produce is not superior. And in a typically materialistic reaction to this situation we have decided to try to produce *more* of the same. Presumably if ten times as many young people decide to pursue science as a career, we will produce ten times as many scientists and be ten times as well off. This, of course, is complete nonsense. Our problem is not one of quantity but one of quality; we don't need more bodies but more brains.

Actually we have learned the lesson that science is important even if we do not understand why. One reaction has been to apply the word science to an array of activities, often disparate. A recent textbook advertisement tells of a physics textbook with the "newest information on nuclear power plants, guided missiles, artificial satellites, high-fidelity sound reproduction, nuclear batteries, jet stream, and electronics in every day living." These are all about things, not ideas. This is not science. But by calling technology science, we can point to an Edison and say: "See! an example of a great American scientist." Incidentally, Edison himself disagreed with this point of view. He once said, "I am not a scientist; if you want to look at the work of a scientist, go look at the work of Michael Faraday."

To return to our initial question, would not most people really think of it as meaning: "How can our knowledge of current technology be used to improve science teaching?" Let us suppose for a moment that we talk about using current technology in teaching.

Suppose that we can take a bright child and mold his future. Suppose we get him genuinely interested in artificial satellites. He begins to collect newspaper clippings about rockets and space travel. We try to put stars in his eyes—and succeed. We tell him that he may go to the moon, to Mars, that the universe is his oyster. What can we hope to get if we succeed? An explorer, or perhaps a rocket engineer. Or suppose we get him interested in automobiles. We could hope that he would become a good engineer and perhaps help to design cars. Or suppose we direct his interest to public health and the exciting things that the medical technologists —not technicians, but technologists—are doing. Perhaps he will become a medical technologist or a physician, but not a scientist.

Actually this is what we are doing. We are teaching technology and calling it science. And we are, generally speaking, successful. We do produce explorers and engineers and physicians. Good! But we do not produce many scientists, and science and scientists happen to be our present concern. This is the pressing question: why do we produce such a fantastically small number of really good scientists in the United States? There is not the slightest reason to believe that Americans are less intelligent or have less creative ability than nationals of other countries. We must somehow be failing to locate the potential scientists among our children, and, when we do locate them, failing to guide them on into genuine science.

That bright young kid who tinkers with gadgets, who builds rockets that win in the Science Fair—which is, of course, mainly a technology fair—may grow up to be a good engineer. He is certainly worth encouraging. But today engineering is the application of the results of science, and who is going to do the scientific work for that engineer to apply?

Now let us return once more, and for the last time, to the original question, and give it still another interpretation—an interpretation that I think can be helpful to us, although it lacks appeal because it lacks concreteness. Let us ask, "What do we know about the nature of current science?" Do we perhaps know enough about what science is to try to stimulate some of those potentials into actualities by using that knowledge in improving science teaching? I think we do.

First, we know that current science as an activity is fundamentally no different from science of the past. To be sure, the theories of science are perpetually changing, but the attitudes of the scientists who create those theories and their modes of working have remained essentially unchanged. This means that we can learn about science from the history of science.

Second, we know that science is a creative intellectual activity pursued only by creative minds.

Third, we know that because science is an intellectual activity, it is likely to flourish only in a culture that respects intellectual attainment. The same is, of course, true for other intellectual activities.

Fourth, we know that a person who is seriously hampered by a lack of intellectual tools cannot effectively devote his efforts to intellectual activity. This means that those high school graduates who can neither read nor write probably cannot engage

(Continued on page 280)

The VP on Science

Remarks by The Honorable Richard M. Nixon at the Silver Anniversary of the Bausch & Lomb Honorary Science Award June 17, 1958, Washington, D. C.

ALL OF US MUST HAVE many thoughts running through our minds, on an occasion like this. There is always a tendency to put these in a personal context. I recall when I was a junior in high school. I had a very remarkable teacher of chemistry whose inspiration made an indelible impression on my mind. It taught me at least to get some basic knowledge in the field of science. More than that it also gave me a picture of how much we owe to teachers in all fields. These people who teach in our grade schools and our high schools and our great colleges and universities inspire literally hundreds of thousands of young Americans to develop their creative ability, not only in the field of science represented at this luncheon today, but in all the other fields which, together, make up the American society we are trying to perpetuate.

I think that we are fortunate that Dr. Nachtrieb [a B & L Award winner in 1933, and now teacher of physics, University of Chicago] is here today because he represents thousands of teachers in all of the schools of this country, in the field of science and in other fields as well. I asked him whether he had any regrets that he chose teaching as a career. "None at all," he said. "You know, there are many compensations in the field of teaching which far exceed any monetary gain that you might receive."

EDITOR'S NOTE: It was my privilege and pleasure to attend the function at which these remarks were delivered. The pertinent points made by the Vice President of our country impressed me, and I felt they would be of interest to you. He spoke with conviction and deep sincerity, extemporaneously without benefit of manuscript or notes. Here for readers of TST is an edited version of his remarks, prepared with permission of Bausch & Lomb and the Vice President himself, with whom I talked briefly. Those who might like a copy of the full text should address requests to Mr. M. C. Williamson, Bausch & Lomb Optical Co., Rochester 2, New York.—RHC

This is something that we often lose sight of—that the teaching profession, underpaid and sometimes unappreciated, is one of the noblest in a free society as our own.

Too often in the United States we get the impression that anyone in order to be an expert of science and complicated, higher mathematics has to be what we call a "square"—somebody who is a little bit on the "queer" side. These two young people (1958 B & L Award winners—Constance Rose of Charles Town, West Virginia, and Thomas Hodgeson of Moorestown, New Jersey) are typical of the students that our schools are turning out today—people who have real ability as specialists in the field of science, but people who are well rounded. You will find more often than not that our young people who go into science and mathematics are people who are specialists but who also have a broad interest in the problems of their schools and who later on, when they go into society, will have a broad interest in other problems as well.

I'd like to say just a word, too, about Bausch & Lomb. I can imagine that there are cynics who suggest it is a pretty good advertising gimmick for Bausch & Lomb to make these awards to 125,000 students over a period of 25 years. All that I can say is, if it were planned as an advertising gimmick, we need more advertising gimmicks of this type.

What I am trying to convey is this: When the first Sputnik was launched a few months ago, the people of the United States got excited about science. Justifiably so. Because for years, we had been hearing about the great gains that the Soviet Union was making in the field of science; not that they were ahead of us overall, but that they were concentrating more in this field than we were; that unless we proceeded to pay more attention to this area than we had, they would overtake us. We had a number of suggestions as to how we were going to meet this problem. Most of those suggestions were with regard to government action. Some of them were rather naive in a sense. Naive to the effect that in order to produce scientists, all you had to do was to have a government program which

would simply turn them out somewhat as you would turn them out by an assembly line. It doesn't work that way, certainly not in a free society where there is a choice among our young people as to what field they desire to devote their studies for the balance of their lives.

Here we have an example of the difference in the approach to this basic problem of a free society competing with a dictatorial society. In a dictatorial society, the State can say what the young people will do. The curriculum, everything else, is determined by the State. And people who have certain abilities in certain areas go into the areas in which they are needed. In the short run, there isn't any question but what they can make very significant progress. And make no mistake about it, the Soviet Union has made remarkable progress (in science), and will make more in the years ahead.

But I think we must never forget that if we lose faith in our approach, the approach of what we term the free society, then we will certainly be lost. Because we need not assume that the only way that you can get scientists that you need is through a government program which literally forces them into this area or that area where they may be needed.

We see here today a typical example, one of many that could be recounted throughout our society, of how American private enterprise working with the public schools systems and private schools of this country has, over a period of twenty-five years, recognized the need and has contributed to the solution and the filling of that need—not through a system which forces young people to do something which they do not want to do, but one which inspires them—not with a great deal of money, but with recognition which can mean even more than a monetary award.

And so, I am very happy to pay a tribute and to express our thanks to Bausch & Lomb, as they represent the other companies of this type throughout the country who have recognized this kind of need and who are engaging in this kind of program. This, in essence, is the most effective way to answer the challenge which is presented to the free nations. Once we recognize a problem, I have no doubt whatever that free peoples working voluntarily with encouragement from government—not with the type of government control which a dictatorial society must have—that a free people with a challenge, working under a free government, can in the end not only survive but surpass materially, as well as in more important areas on the spiritual side, people who live under a system of slavery.

Federal Support for Science Teaching

The National Defense Education Act of 1958, a four-year bill strongly supported by the National Education Association, NSTA, and other organizations was passed on August 23 by the United States Congress after considerable debate and compromise.

The bill (H R 13247) is one of the most extensive legislative acts in support of education in the history of Congress. Designed to meet present education needs, although devoid of the original scholarship provisions, the measure will provide an approximate $900 million fund for assistance over the next four years in loans totaling—

- $295 million to needy students;
- $ 60 million for post-graduate fellowships and the preparation of teachers for college and university levels; and
- $300 million in Federal aid to states for facilities and equipment to teach science, mathematics and foreign languages.

The U. S. Commissioner of Education, together with institutions of higher learning will administer the student-loan program which provides loans up to $1000 a year at 3 per cent interest to be repaid beginning one year after graduation. Recipients who later enter and continue in teaching assignments for five years will be allowed a debt cancellation of one-half of their loans.

The balance of the $900 million fund will be allocated to assist:

- ► Institutes for teachers to learn counselling .... $28 million
- ► Institutes for training foreign language teachers .... $29 million
- ► Guidance, counselling, and testing programs (grants to be matched by states) .... $60 million
- ► Centers for studying modern foreign languages .... $32 million
- ► Research and experimentation on improved educational use of television, radio, and audio-visual aids ...... $18 million
- ► Improvement of state educational statistics .... $6½ million
- ► Vocational education in skilled trades for defense .... $60 million
- ► Authorization for a scientific information center to be financed in part by the National Science Foundation... ——

The National Education Association has recommended Federal support for education for more than 75 years. In July of this year, at the annual NEA convention, a resolution was adopted by 6000 teachers and administrators by unanimous vote to continue this support and back the proposed bill before Congress. The legislative committee of NEA went to work to transmit the convention resolution to the Congress, and has constantly kept these views alive before the groups considering the education bill.

In February, at congressional hearings held by the Senate Committee on Labor and Public Welfare, Chairman, Lister Hill, NSTA officers Glenn O. Blough, President, and Robert H. Carleton, Executive Secretary, presented testimony on the major problems of science teaching in the United States. Similarly, written testimony was submitted to the House Education and Labor Committee, Chairman, Carl Elliot. Recommendations were made to these committees for the improvement of science teaching at the elementary and secondary levels, and an outline presented of the needs of teachers and students and of the necessity for expanded facilities and equipment. Following the hearings, the NSTA prepared two mailings of information to life and sustaining members and leaders in the profession urging them to submit their views, for or against, the proposed education bill (H R 13247). Many of the NSTA recommendations are included in the measure as passed. As one congressional leader remarked, "It was the work of the NEA and the many expressions of support from teachers all over the country which helped to get the bill off the ground."

The conference report on the bill is given in the Congressional Record Proceedings of the 85th Congress, Second Session, August 21, 1958 (104:146, p. 17500).

From Research to Classroom Laboratory...

REDUCING EVAPORATION OF WATER BY USE OF HEXADECANOL

A Teacher-Pupil Activity for Chemistry Grades 10-12

By T. HANDLEY DIEHL

Central High School, Cincinnati, Ohio

and F. M. MIDDLETON

Science Director in Charge, Organic Contaminants Studies, Robert A. Taft Sanitary Engineering Center

Background

Much water is lost every year by evaporation from lakes, reservoirs and ponds. In arid areas, such as our own Southwest, and in many other parts of the world the conservation of water resources is of extreme importance. Reducing evaporation also improves the quality of water by preventing the concentration or minerals.

Hexadecanol (also called cetyl alcohol) is a compound that is receiving study for use in evaporation control. This compound, most of which is derived from sperm whale oil, has the property of forming a monomolecular film on water. Such a film prevents the water from evaporating but at the same time permits the passage of oxygen from the air to water and water to air which is important to maintain freshness. Reduction of 20 to 70 percent in water evaporation has been reported from the use of the hexadecanol. Australian scientists have studied the use of hexadecanol and now many agencies in this country, governmental and private, are investigating evaporation control.

Some of the problems of using such a material include:

1. How to spread and maintain the film.
2. A study of the economics of the use of the material. If it costs more than the value of the water saved, control may not be warranted.
3. The life of the film, and its effects on the water are of importance.
4. Materials used should be free from harmful effects on animal or human life.
5. Methods are needed for detection and identification of the hexadecanol in water.

The Robert A. Taft Sanitary Engineering Center in Cincinnati, along with other agencies, has studied some of the problems connected with the use of hexadecanol as an evaporation retardant. The material appears safe to use as proposed, it does not appear to affect fish life, and water treatment processes are not affected. Laboratory tests have indicated that the hexadecanol is decomposed by biological action. This is a factor that will need further evaluation since rapid loss of the film could be important economically. How to make a resistant film is a topic that would require research.

It is difficult to detect and identify the amounts of hexadecanol in water that are used in preparing the films. One way of doing this is to concentrate the material from water by collecting it on activated carbon. The material is removed from the carbon with a solvent and examined in various ways. It can be weighed, the melting point can be checked, and an infrared spectrum can be run. If interfering materials are present, further purification steps are required.

In the experiment which follows you can test the ability of hexadecanol to retard evaporation and recover and identify the material from solution.

This article continues the series of teacher-pupil activities in science which have been featured in *The Science Teacher* issues, February through May, 1958. Collated reprints of these articles are available without charge. For information or orders, write to: Public Inquiries, U.S. Public Health Service, Washington 25, D.C.

PART I

TESTING EVAPORATION CONTROL

Statement of the Problem

To demonstrate how evaporation is controlled by hexadecanol.

Materials

1. Two trays having a surface area of 80 square inches or more and at least a depth of 1 inch.
2. 1000 ml graduate or volumetric flask.
3. Hexadecanol—Obtain from Scientific Supply House.

Procedure

A. Add equal volumes of distilled water to each of the two trays and place them in a place where evaporation can take place. A dry atmosphere is best.

B. Place some hexadecanol on one tray so that an excess over that required to form the film is present. At least 0.005 g per square inch should be provided. Leave the other tray for a control.

C. At the end of a week or sooner if evaporation is fast, measure the volume of water left in each tray. (Do not permit the bottom of the trays to become exposed before measuring).

D. Did the hexadecanol retard evaporation? What percentage of the water was saved?

E. Try some other materials—motor oil, mineral oil or kerosene. Why are such materials unlikely to be useful?

PART II

RECOVERING AND IDENTIFYING HEXADECANOL

Statement of the Problem

To demonstrate the recovery of hexadecanol from water.

Materials

1. A carbon filter (see May, 1958 issue of *The Science Teacher*, p. 197 for directions and p. 196 for source of carbon.)
2. Reflux distilling apparatus (water condenser and 500 ml round-bottom flask)—see diagram.
3. A Waring Blendor or other stirring device.
4. Hexadecanol
5. Chloroform
6. Funnel—filter paper

PUBLIC HEALTH PHOTOS BY DON MORAN

Hexadecanol placed on water surface.

7. Separatory funnel
8. Water bath and thermometer
9. Bunsen Burner

Procedure

A. Set up the carbon filter. Pass 200-300 ml of distilled water through the filter to wash out the fines. (See Figure 1.)

B. Warm approximately a liter of distilled water to 80°C.

C. Weigh out 50 mg of hexadecanol. Add this to the warm water and mix with the Waring Blendor. (This forms an emulsion.)

D. Drip the hexadecanol-water emulsion through the carbon at a rate of 8-10 ml per minute. The hexadecanol stays on the carbon.

E. After the solution has passed through the carbon, take the carbon out of the tube and spread it out on a glass plate to dry. (A day or two may be required for the carbon to become dry. The carbon should flow easily when dry.)

F. When the carbon is dry, pour it into the round-bottom flask. Add about 200 ml of chloroform and reflux the mixture for 3 hours. (See Figure 2.)

G. Filter the chloroform (use a hood) from the carbon.

H. Evaporate the chloroform to dryness under low heat, collect the hexadecanol residue and weigh on an analytical balance.

I. What per cent of the material did you recover?

J. Place the beaker containing the residue in a water bath containing a thermometer. Warm the water gently. Record the temperature at which the residue melts. If the hexadecanol is pure, it should melt close to 50°C.

Discussion

In actual practice, the hexadecanol would be mixed with other organics that occur in water. It is then necessary to separate the hexadecanol, and run tests such as infrared to determine whether the material recovered is actually the alcohol.

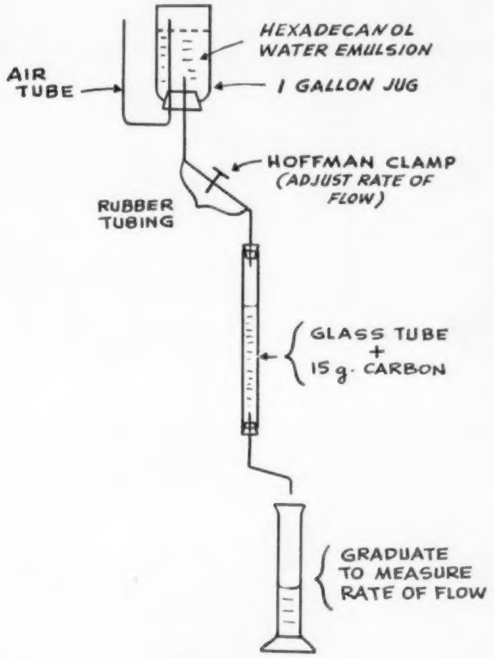

FIG. 1

Suggestions for Further Study

1. Try some pond water instead of distilled water on the evaporation test. What problems occur?
2. When hexadecanol oxidizes carbon dioxide is given off. See if you can set up a biological oxidation system and collect or measure the carbon dioxide. (Suggestion: Use a pond water to set up the biological system.)
3. Try various concentrations of hexadecanol per square inch of surface area to determine what concentration gives the most favorable result.

REFLUX CONDENSER

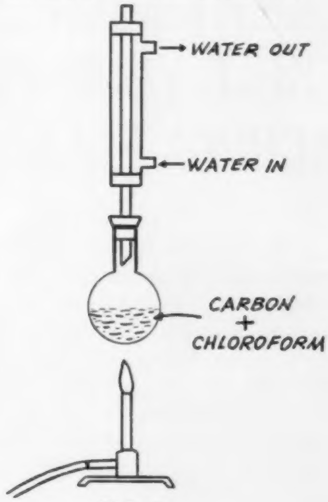

FIG. 2

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STUDENT SEMINAR AT PUBLIC HEALTH CENTER

By JOHN DURRELL

Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio *

"I had no idea that research work was so many different things. You can work in a laboratory, but the people here travel and do field work, and their lab work seems to include many things."

This was the comment of a senior high school science student who participated in a recent "Science at Work" seminar at the Public Health Service's Robert A. Taft Sanitary Engineering Center in Cincinnati.

The Seminar, an all-day affair, was a big package for the average student to absorb, but those attending it were not average students. The 19 students represented 19 Cincinnati public and parochial high schools. Most were seniors and all had good science and mathematics backgrounds. Each student was selected by the science teaching faculty of his or her school as an outstanding student in these areas.

The student seminar, the first such conducted by the Sanitary Engineering Center, was arranged by Kenneth E. Vordenberg, Supervisor of Science, Secondary Schools of Cincinnati, and Father William Franer, Assistant Superintendent of Schools, Archdiocese of Cincinnati, in cooperation with the Training Program of the Center.

The basis of the Center's participation in the seminar was a recent request by the President directing all government agencies to consider means of stimulating the more effective development and utilization of scientists and engineers.

The Sanitary Engineering Center itself is a unique operation. As the research arm of the Division of Sanitary Engineering Services of the United States Public Health Service, it conducts under one roof an astounding array of both pure research and applied engineering research in the field of environmental sanitation. This includes water resources and water pollution, atmospheric pollution, milk and food technology, and radiological health hazards.

In addition to research, the Center renders technical assistance and consultation to States, communities, and industries requesting help, and conducts an elaborate training program for engineering and related personnel in government and industry.

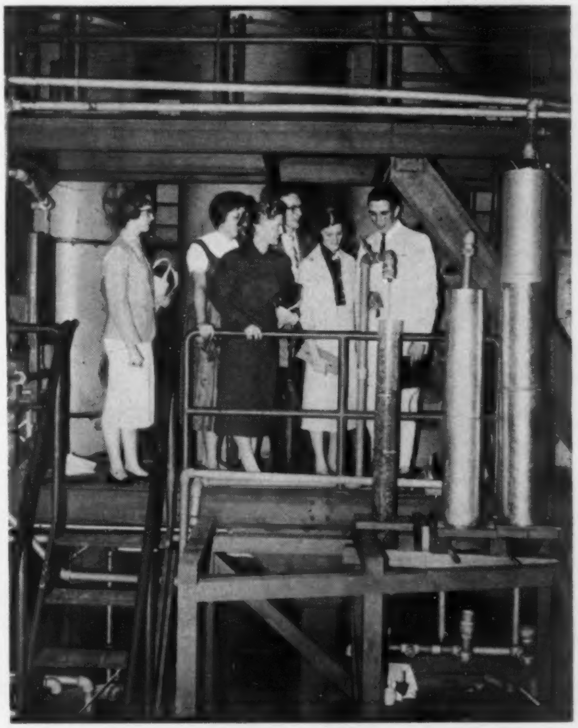
The Training Program staff thus organized this first student seminar.

The group met at 9 a.m. in the Center's auditorium. After a brief welcome by the Director and Assistant Surgeon General, Harry G. Hanson, the functions of the Sanitary Engineering Center were outlined.

Following this orientation, the students had their first contact with environmental research activities in the Water Supply and Water Pollution Program. They saw the movie, "Pipeline to the Clouds," which details the water cycle and the means of pollution, utilization, and conservation of available water

Visit to Taft Center Pilot Plant. Shows column used to test size of aggregate on time flow. (Betty Ann Punghorst, Regina High School; Sally Sherman, Mother of Mercy; Gayle Spoehrer, Our Lady of Angels; David F. Moneau, St. Xavier; Gretchen Wehrmeyer, St. Mary's; and Frank W. Jones, Purcell High School.)

PUBLIC HEALTH SERVICE



*Research unit of Division of Sanitary Engineering Services, Bureau of State Services, Public Health Service, United States Department of Health, Education, and Welfare. (See page 254 also.)

supplies. The student then saw demonstrations of organic trace subtance and fungi by researchers in these fields.

The Community Air Pollution Program section of the seminar opened with a motion picture report on the Los Angeles smog program. Laboratory demonstrations of analytical physical and chemical research in air pollution were presented.

The seminar was divided into two sections for the Milk and Food program demonstrations. One unit heard a discussion of shellfish poisoning. A second saw demonstrations of milk pasteurization equipment and colorimetric chemical tests for food purity.

The radiation section was of great interest to almost all members of the seminar. After an introductory talk in which instrumentation was discussed, the students made actual radiation measurements. Radiation dosimeters were distributed for calibration by each member of the group. The dosimeters were exposed to a source, an X-ray shoe fitting machine, and then read by the individuals.

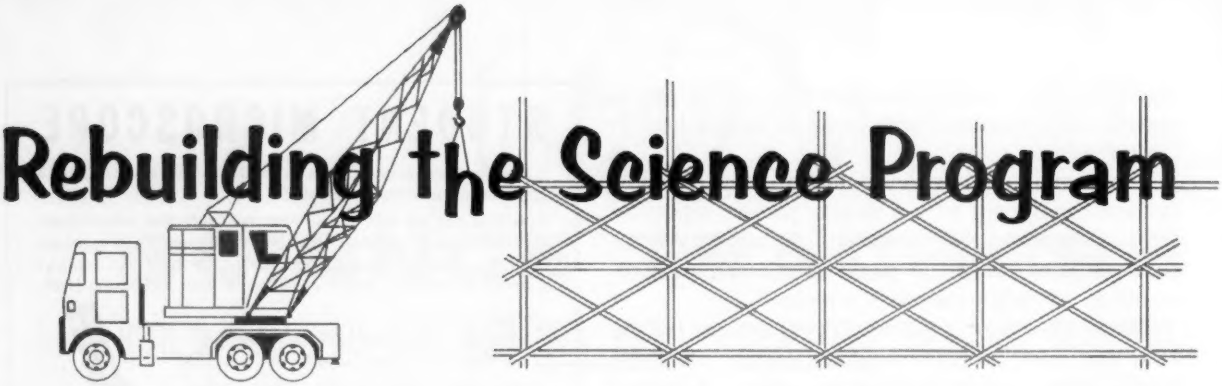
The final laboratory visit of the day took the members of the Seminar to the Sanitary Engineering Center's pilot plant area where water treatment and waste treatment equipment under development is tested.

The seminar was concluded with a talk by Bernard W. Berger, Chief, Water Pollution and Water Supply Program. Mr. Berger's topic was the still unsolved problems of sanitary engineering, some of which may be the special problems of researchers in the next generation. He cited a number of problems from each of the areas of research which the students had visited.

In each of the separate programs, the students saw a film, observed experiments, spoke with senior research investigators, and then participated in limited activities where possible. The group demonstrated exceptional interest in and understanding of the day's activities, compressed though they were into a nine-hour intensive schedule.

More such tours are contemplated by the Center for both students and science teachers as a contribution toward the stimulation of greater interest in science in general and engineering in particular on the part of students who might recognize in exposures such as this the desirability of a career in science.

Applications for Opportunity Fellowships for 1959-60 of the John Hay Whitney Foundation should be filed not later than November 30. Awards range from $1000 to $3000 to provide opportunity for special experience or advanced study. Address inquiries to: Opportunity Fellowships, John Hay Whitney Foundation, 630 Fifth Avenue, New York 20, N. Y.



Elementary Science

Teaching Elementary Science to Gifted Children

By PAUL E. BLACKWOOD

U. S. Office of Education, Washington, D. C.

HOW shall I help gifted children in science? Every teacher must face this question because every classroom has children who are either very capable or very interested in science. The unresolved issues about ways of dealing with children's individual differences seem to be accentuated when rare talent is concerned. One question is, "Who is talented in science?" Certain researchers say that there is a clearly defined trait of science talent that can be identified, analogous to musical talent or artistic aptitude. One researcher, at least, thinks this talent is demonstrated in a special sensitivity to problems, flexibility of mind, novel ideas, and ability to evaluate. Another believes the science-talented child has specialized and persistent alertness in detecting inconsistencies, creative imagination, and a high degree of mechanical-mindedness.

Other authorities argue that there is no single trait of science talent *per se*, but that science talent is one aspect of general high intelligence which emerges through environmental stimulation with science opportunities.

But the elementary teacher cannot postpone helping children until the nature of science talent is clearly explained. The fact remains that some children are very eager to know more science than other children. Some learn science much more rapidly than other children. Some are bright in everything. Some children seem to be science prone. In a general way this article is concerned with all of these children.

How shall they be helped most? Here are several suggestions which seem to "hold water."

1. *Involve children in planning the science study.* This means all the children in your classroom. All children, including the bright ones, will make suggestions of questions to study, topics to consider, resources at hand, and ways to proceed. When children contribute to the planning, more possibilities are proposed of things to do than each child can do, and it is possible to guide and direct the bright children in doing some of these relevant and important things. Some child may do them for his personal knowledge and satisfaction; some he will do for and with other small groups of children; some he will do for reporting to the entire class. This suggestion aims at emphasizing how enrichment of the bright child's program is easier when the total context of the science program is rich.

2. *Expect and require bright children to know more than other children.* Though there are usually certain understandings that most children in a class should know about topics being studied, there is no reason for limiting the knowledge of all children to an agreed upon minimum. If given the opportunity, the encouragement, and the time, bright children will acquire more knowledge. But they need help, too, in knowing where to get information and what is expected of them. Bright children ought not to be limited either to what the teacher knows about a particular subject. A mark of a good teacher is to find that her pupils are out-stripping her. They should be congratulated for it.

3. *Continually think of science as a kind of inquiry that requires investigation* in a variety of ways —experimenting, observing, talking with experts,

The three following reports by P. E. Blackwood, E. T. Hadlock, and D. A. Schaefer represent a selection of articles which will be included as a continuing series. The series will cover reports on new patterns, tested experiences, and provocative ideas for revising content and organization of courses and curricula in science. In the selection of articles for this series, emphasis will be placed on: (1) provisions for working with able students highly motivated in science; (2) sequential development of the science program, K-12; and (3) modernizing internal content of courses at all grade levels.

Readers are invited to submit reports falling within the scope of the series, particularly if the reported efforts have been recently tested and evaluated. Bibliography should accompany manuscript; indicate also availability of course outlines, or materials for readers who may wish further information.

reading, seeing films, etc. Science *is* investigation through which knowledge about our universe is acquired. When teaching reduces science to inquiry through any one source of information, then it is teaching that limps along. And the bright child will not be stimulated much at all.

4. *Provide opportunities for bright children to read a variety of books* and use materials appropriate to their interest and skill. Though books are just one source of information, they are an important source. Let the bright children reach to the high shelf, if that is where the best or more difficult books are.

5. *Provide opportunity for bright children to study topics and problems of special interest* in addition to what the class as a group is studying. A way to nurture real science interest or talent is to allow a child some free rein to study problems of consuming interest. In such a situation a child still needs much support and advice. The teacher may help him best by locating another person (student, teacher or parent) to help him with his immediate science interest.

6. *Plan special responsibilities to challenge and interest the bright children.* This may be such things as calculating the relative humidity from available information about humidity and temperature. It might be reporting on what holds a man-made satellite in its orbit; or why it will fall from its orbit; or writing a play or story based on scientific information. Sometimes the special responsibility will be just a one-time task. Sometimes it can be an on-going job which is a little too difficult for the average child to accomplish. Yet it is an important and useful job to have done regularly. Such jobs may be: keeping a record of certain weather facts from the daily paper; measuring the loss of water by evaporation from a container; measuring the change in length of a stick's shadow at a given time each day; finding "experiments" that relate to the study which someone can do for the entire group. These examples have meaning only as they are thought of as things a little more difficult than most of the children in a particular group would be expected to be able to do profitably.

Science instruction for most children in most schools in the Nation will be carried on within the regular classroom for many years to come. In view of this realistic prediction, one negative suggestion will be given. In the elementary school, do not make the opportunity to engage in science activities or projects the reward for doing well in other subjects, or a reward for those who accomplish some pre-assigned task in order that they "may be allowed" to study science. This is a very difficult point to establish. An example will help. A teacher, as a general practice, should not say "When you have finished your reading assignment, you may work with the magnets." Or "When you have completed your arithmetic problems, you can look through the microscope." Or "If you learn your spelling words, you may wire the electric bell and batteries." On the basis of such general practice, some children would never get the opportunity to do those things. Indeed there is some evidence that apparently disinterested children of real ability may have their dormant interest stirred through the very kind of opportunities that they may be deprived of if denied opportunities in science until other barriers are cleared. Opportunities for science experiences should be a part of the total plan so that all children will have such opportunities in the elementary school. Additional and enriched opportunities for the science gifted may be included as part of the total plan.

BALTIMORE CITY SCHOOLS

This Is the Way We Do It

By ELOISE T. HADLOCK

Boynton Junior High School, Ithaca, New York

This report was an entry in the 1957-58 STAR (Science Teacher Achievement Recognition) awards program.

THE purpose of this paper is to convince teachers of general science that a meager amount of laboratory equipment does not necessarily hamper gifted students interested in gaining skill in scientific problem solving. It is further intended to show that improved laboratory work gives the students the satisfaction and insights that come from experiences with handling equipment and utilizing the scientific method. Thus we are encouraging more young people to consider careers in science and engineering.

For some time the science teachers in our school had felt that our science curriculum was not sufficiently challenging to our groups of high ability. This opinion was shared by the mathematics department. In May of 1956, we carefully studied mathematics and reading scores obtained from the Iowa Basic Skills Tests and those obtained by a New York State School Survey Test in General Science. It was concluded that of 350 students in grade seven, there were 60 students who could profit by an enriched program in eighth-grade science and mathematics. The proposed program [1] was outlined for two high ability groups of 35 persons. The students relayed the plans to their parents, who were encouraged to call the faculty and guidance department for further details. At the end of a two-week period, sixty of the students signed up for the course.

Time and Materials

The standard curriculum for grade eight was designed for a twenty-week term. To lengthen the course to forty weeks it was necessary for the students to be excused from Language Skills.

Our laboratories are equipped with movable tables, but without gas, electricity, and water supplies at each table. The science storeroom which adjoins the laboratories was pressed into service, giving us six gas outlets, eight electric outlets, one hot water and two cold water connections. We have a total of three compound microscopes, and three triple beam balances.

Methods

No new units were added to the curriculum. The emphasis was on laboratory techniques, creative activity, critical thinking, and problem solving. A class of thirty students was subdivided into five groups. Group "A" learned to use microscopes, and to prepare temporary and permanent slides; Group "B" worked with measurements, learning how to use balances and became familiar with the metric system as applied to length, volume, and weight; Group "C" studied scientists and scientific methods; Group "D" surveyed career possibilities in the fields of science and engineering; while Group "E" worked on individual experiments, suggested by "Things of Science" and various science books. At the end of a two-week period, a test was given to

CHICAGO PUBLIC SCHOOL PHOTO

[1] For further details on problem summaries or questions, direct inquiries to Eloise T. Hadlock, author.

PHOTO BY LELAND JR. HIGH SCHOOL, CHEVY CHASE, MD.

each group and the students moved into a different group. The shifting from group to group continued until each student had experienced the five areas. The group change involved learning by doing to one of learning by reading, and then to another of doing. Each time the students moved to a different group, the student leader also changed thus giving opportunities to develop leadership ability in each student.

The class decided that there should be guest speakers representing the five major sciences. After polling the interests of their classmates, members of the group arranged for the speakers. [One speaker was Dr. Noah Kassman, a practicing physician in our community, and another was Dr. Hans Bethe, of Cornell University, who spoke on the source of the sun's energy.]

Another phase of the program was a study of science principles. Lists of suggested biological, physical and chemical principles were provided. Each student chose one for careful study, and later presented a report to the class.

More than half of the members of the class prepared projects and exhibited them at the district Science Fair. One of the girls earned a First Award with her stained and preserved chick embryos.

Results

While participating in the program the students prepared bulletin boards, listed Nobel Prize winners in chemistry and physics, listed modern scientists and their area of work, displayed collections, and took their projects to the elementary schools in the city where they explained them to members of the science clubs in grades four, five, and six.

At present these students are in ninth-grade science class with the same classmates and the same science teacher of last year. The curriculum for them is that planned for other ninth graders, but with the gifted group taking more initiative in directing class activities through teacher-pupil planning, preparing projects, attending lectures at Cornell University, watching television programs, and becoming the leaders in club programs. Four members of the group have assigned themselves set hours in the science stock room to help teachers in the department.

Both students and parents have been so favorably impressed by the program that two more eighth grade groups are participating in a similar program this year. Next year we will have four groups of eighth graders following the program.

The high school science department plans to keep the sixty students separate from other students who have had a different background. It is hoped that since all are college-bound that their choice of electives will make it possible for them to remain with the same group of the past two years. Their records will be carefully noted and their choice of careers will be observed and followed up wherever this is possible.

Advanced Science for Gifted Students

By DONALD A. SCHAEFER

Bettendorf Senor High School, Iowa

This report was an entry in the 1957-58 STAR (Science Teacher Achievement Recognition) awards program.

IT is the intent of the author to explain the nature and purposes of an advanced science course which was placed recently in our curriculum for gifted students. An attempt will be made to clarify the reasons for this course—for which there is no specific text—and explain some of the areas selected. The requirements for membership in this class, and some of the factors being considered on the basis of a current year's work will be covered as they may affect these requirements in the future. The ultimate plan is described briefly of the place for this course in the science program, for maximum utility to the gifted student, without elimination of the average student from the science program.

The fundamental problem in a course such as this proves to be the selection of material to be used; and this depends entirely upon the purposes of the course. The backgrounds and aptitudes of the students, the background of the instructor, and facilities available are additional limiting factors. Probably the most controlling factor is the philosophy of the instructor and the administration as it regards their goal for such a course. In this case, the expression of the administration was to allow complete freedom in the subject matter to be included, as well as in the student requirements to be established.

To determine the material and the approach that might prove to be the most advantageous for students at higher levels, the author had the distinct advantage of working with science teachers from many areas of the United States while studying in an academic year program during 1956-7 at the University of Wisconsin. In trying to develop a composite picture of what *was* being done in the advanced type course, the somewhat disconcerting thought evolved that—there is really no consistency of opinion as to the type or purpose of such a course. It became almost as apparent to this writer that there is really no consistency of opinion as to the primary function of our high school courses in chemistry and physics. Without a definiteness of purpose in these courses, it appears to this writer that there is really no reason to suspect that anything of a definite nature should result. This, in itself, constitutes a major weakness in science education. All of these considerations and observations ultimately indicated that most of the decisions regarding course content and course requirements would be primarily a matter of instructor responsibility.

Student Characteristics

The following information was compiled on the students: the group was small and highly select, and were all college-preparatory students. Each of the five initial members of the course had taken a course in chemistry, and two had taken a course in physics as well. All had taken work in intermediate algebra, and one was enrolled in physics as well as advanced science. On the basis of mental ability tests, achievement tests and academic records, the students were classed as superior. There was a great deal of uniformity, therefore, in mental level but only some uniformity in their background.

Courses Considered

The special subject course, as well as the special interest course, was ruled out. The special interest course—such as electronics, photography, or astronomy—was judged to be more a matter of student preference than student aptitude. If such a course was to be used for gifted students, it was judged that more uniformity of background and interest would have to be in evidence than was indicated by the available information. The special subject course—such as qualitative analysis, quantitative analysis or organic chemistry—was eliminated largely due to what might be considered a somewhat prejudicial attitude on the part of the author. A course such as qualitative analysis, or organic chemistry is usually employed at the high school level for one of two reasons. Either it is an attempt

to supply the student with sufficient information and techniques to completely by-pass the same course on the college level; or it is reasoned that the student may take the same course again and still gain a maximum of value. This writer subscribes to neither view point on the basis of the following opinions: (1) That high schools in general cannot supply courses under high school limitations that will actually insure a high enough degree of student comprehension to allow the students to skip the corresponding college course without later difficulty. Ordinarily the short laboratory periods, general lack of student time, study habits that are generally not intensive enough, and lack of facilities would make the degree of comprehension desirable a highly improbable result—even if instructor background were specialized enough to insure accurate information being transmitted. (2) On the other hand, with students of very high basic ability, the necessity of *total* repetition of the same courses on the college level is nearly as unrealistic a viewpoint, if a maximum of value is to be gained from student time.

Selected Course Purposes and Characteristics

On the basis of the preceding information and opinions, the following plans and goals were formulated:

1. The course should better prepare these students for transition to college, and the expected college study habits.
2. It should be challenging to the level of student in the course. It should be as quantitative as the background and aptitudes of the students will permit.
3. Because of lack of complete uniformity of college plans, it should provide students with background which is likely to prove applicable to various future science plans. Introduction to newer concepts, to probability instead of certainty etc., should make for more complete comprehension when these aspects are again encountered.

PHOTO BY RAY E. WHITE, QUINCY, ILL.

4. Introduction to experimentation of a research nature should be of a much more realistic nature than the regular 50-minute verification type in regular courses. Research project to be required of each. This should allow somewhat for interest difference.
5. The course should show vividly the interdependence of the sciences and mathematics; and every attempt should be made to show the students where each area might be encountered in further study.
6. Scientific theory, past and present, should be developed from a logical and historical basis and should indicate how each is dependent upon the evidence available at the time. Spectroscopy and its effect on atomic structure theory should afford an excellent opportunity.
7. If possible, the course should provide the students with *specific tools or methods* which will be of service to them regardless of their particular area of future study. The Factor Method, or dimensional analysis method is equally applicable to quantitative chemistry, physics or biology.
8. It should be flexible enough so that alterations can be made, if it becomes apparent that the material is too difficult, or if it is obviously not in accord with the capabilities, interests or future plans of the participants.

Course Content

Since space will not permit complete discussion of each area selected in the course, the following plan of presentation will be followed: Only a few of the specific areas covered will be discussed in detail.[1] Attempted generalizations will be made for the areas not discussed in detail.

As the class began, the first week was used primarily in orienting the students to the newly planned course, acquainting them with the reference college texts and materials to be used, and discussing the requirement of an accompanying research project to be included as a part of the course. Numerous lists of projects were distributed, slides of projects at the National Science Fair (1956) were shown, and each student was aided in what is probably the most difficult part in beginning project work—the selection of a project in which the student has interest, and which has some potential from an experimental standpoint.[2]

Each student was required to have a slide rule. By the end of the first two weeks, each member of the class had obtained a rule of the trig or log-log

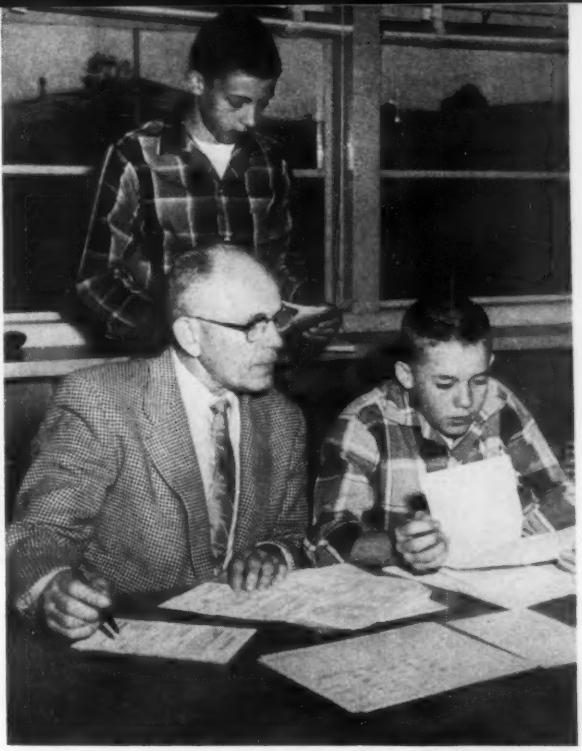
[1] For those interested in a complete detailed table of contents and references, the author will furnish copies on request.

[2] List and description of projects chosen will be furnished by author on request.

type. The study of the slide rule in this group was approached through an understanding of the theory of construction of the rule, and not *just* its manipulation. Where it was possible, the students predicted the mode of construction of the various scales on the basis of a short review of the use of logarithms. In this way, both the theory of construction and the mastery of manipulation of the C, D, A, B, K, L, S, T, ST, CF, DF and inverse scales were achieved. Problems in the rest of the course were then set up so that one series of operations of the rule would give the answer; and, three-place accuracy became the norm. With the natural increase of confidence resulting from continued use of the slide rule each student became very proficient in the computations.

In problems of chemistry, problems involving forces, energy etc., a *maximum* of emphasis was placed on the understanding of dimensions and units. With the use of the factor, or dimensional analysis method of problem solving, it soon became apparent to the students that, not only was it practical to place such importance on correct units, but in most cases it was an automatic check on the validity of the results. The work involving molarity, equivalents, normality, pH and series or equilibrium reactions was approached from the factor stand-point with the emphasis on handling of units. From equilibrium reactions, equilibrium and ionization constants, ion and solubility products, the general theory of qualitative analysis was introduced, and a few examples of selective precipitations carried out by demonstration and student experiment.

During the second semester, the work was planned to relate the discoveries and theories of the physicists with the observations of the chemists; and, to show the necessity for the work of both in present-day biological studies. Then, it was shown that the language which binds all of the sciences together is that of mathematics—so that the necessity for an understanding of and tolerance for the whole is required, in addition to a great accumulation in a narrow area. In each case where a presentation of a theory is involved, the approach was one of "What evidence leads to this possible explanation?" Where the background in mathematics will permit, the procedure will be to show historically and mathematically the development of theories regarding the mass and charge of subatomic particles, and of the atom itself. In connection with the study of this evidence, an introduction to the laws and formulations for electrostatics and electromagnetics is included, in order to



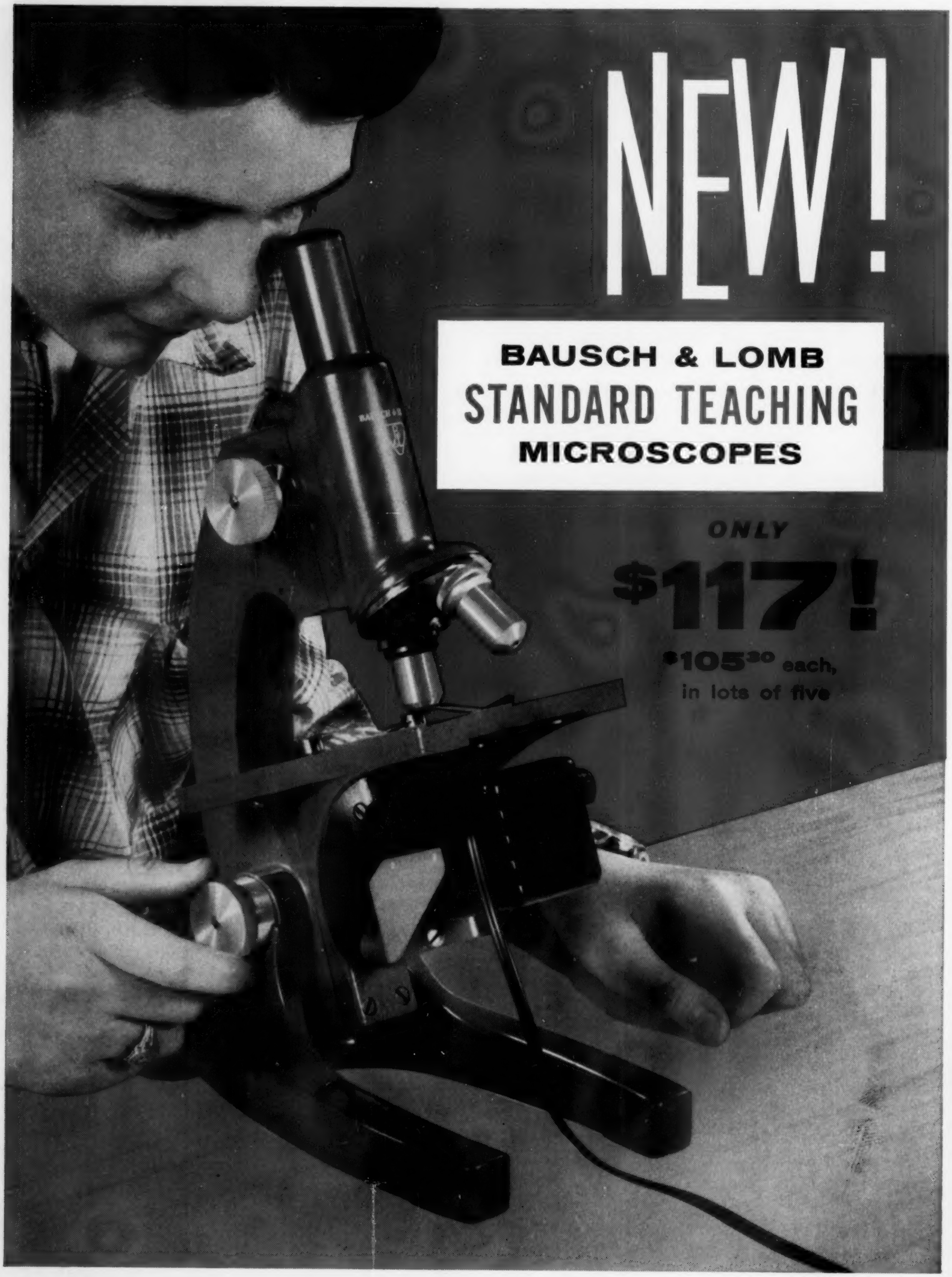
BAKERSFIELD CITY SCHOOLS, CALIF.

understand the evidence. The work of Thomson, Millikan, Rutherford, Bohr, Planck etc., are considered from a qualitative and quantitative basis—though much consideration of the quantum theory must remain outside the realm of high school study.

From the work of spectroscopy, an introduction to the concept of energy levels—sub-shells, s, p, d, and f electrons—and to the applications this has to the chemical and physical properties of the elements—is given. With some success here it should be possible to explain magnetic properties of some metals, to clarify some of the confusing characteristics of the transition elements; and, in general to show that the periodic table—properly interpreted—constitutes a powerful academic tool.

Toward the end of the course, the purpose is to show by over-all considerations, as well as by specific examples, the dependence of modern biological research upon the acquisition of a background in mathematics, physics and chemistry. Illustrative studies of electron microscopy, biochemistry, X-ray diffraction studies, and present research into the nature of metabolic processes, differentiation, the Krebs cycle, and the nature of sight or nerve impulses should aid in erasing some of the erroneous thinking which identifies present-day biology as a library science course, or as a collector's quasi-science which is purely descriptive. As one whose primary interest is in physics and chemistry, this writer must admit to a similar viewpoint before being privileged to work under two research biologists in Wisconsin. This attitude, held by too many

(Continued on page 286)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PROJECT "PAPER DRIVE"

By ROBERT S. JAQUISS

General Science Instructor, Seward, Nebraska, Public Schools

EARLY in my first year of teaching I suddenly came to the realization that we needed some project work to do in the General Science classes. Since biology is required here in the sophomore year, it is not included in the General Science curriculum. In order to give the students an opportunity to show individual creativeness and also to give them an opportunity to concentrate some of their effort in a field of their own choice, it was decided to prepare scrapbooks. Accordingly, five topics of interest were chosen. These were: Birds, Mammals, Fish and Reptiles, Insects, and Plants. After becoming organized, we began a frenzied hunt for material. Friday became our special day. On alternate Fridays, we would discuss the current science paper and work on Scrapbooks.

The continual problem was the lack of material. In spite of this handicap we finished up the year with five, County Blue Ribbon Scrapbooks. The three sections of General Science each had from two to five students working on the same scrapbook. One group made the cover, another arranged the inside pages, while another group completed work of binding the books. Each group mounted their own material on pages. It is fascinating to watch a work like this plod along, at times seeming hopeless, and then seeing it to completion.

We obtained most of our scrapbook material from current and past-dated magazines. It is my opinion as a teacher that one of the great but too-little-used resources in education is the current magazine. These sources with their pictorial beauty and excellent technical reproduction present accurate details of current topics, and supplement the textbook in many ways. To be sure educators have said, "Keep a picture file." Many teachers do. But, this takes a lot of work and, particularly, time on the part of the teacher.

As an example, our textbook contains some excellent diagrams of an underwater caisson. But there is not a picture of one in actual operation. (After all, there is a limited amount of space in a textbook, and something has to be left out.) This year when we were studying the General Science unit on water, I came across a copy of a magazine with the story of the closing of the Dutch dikes after a period of floods. The operation was done by floating a huge caisson into the water at high tide and then sinking it in position. The same magazine carried pictures of cleaning out the silt that accumulates in an underground reservoir. We were able to make use of these illustrations in class discussion.

Pictures such as these are a valuable asset in teaching. Why not then let the students help in finding such items, and in building up a picture file for the school. In our project, the "file" took the form of scrapbooks.

In order to have material from which we could make selections, we decided on a paper drive. A paper drive sounds like a lot of work for everyone concerned. It is. We began in the fall to collect paper every Saturday. The town was divided into districts and groups of friends were assigned to cover the territory. The students called from door to door, collected the papers and magazines and piled them on the curb. Later other students loaded the material in a trailer, and took it to a garage for sorting, bundling, and storage.

Each Saturday we picked up almost a ton of material (worth about $8.00 a ton), for the scrapbook "file." After school the students would come to the garage and sort the material according to the subjects selected. In later classes, we added new subjects to the scrapbook and also made sub-divisions of the topics. The new subjects were: Rodents, Furbearing Animals, the Deer Family, Prehistoric Monsters, Garden Flowers, Wild Flowers, Trees,

Blue Ribbon Scrapbook

Game Birds, Game Fish, Tropical Fish, Atomic Energy, Nursing, Medicine, Drugs, Airplanes and Automobiles.

One of the results from the paper drive was completion of one set (and several partially complete sets) of the "World We Live In" series from *Life*. We have the bound volume of the series in our library, and these sections will be individually bound, other material added, and available.

The parents cooperated also, and willingly allowed the students to participate on Saturday mornings, and sometimes in the afternoon. Do not be mistaken, there is much work involved in a paper drive. The students did almost all of it, and with a minimum of supervision. They planned it. They carried it out by using a lot of stick-to-it-ness, and by doing their own chores at another time which they might have used for leisure.

For our class, the scrapbooks and paper drive have been worthwhile projects, because:

1. The pictures and articles collected went into scrapbooks in organized form for future reference.
2. Money was added to the class treasury. (It was actually a class project.)
3. Students learned to take responsibility, to organize their activities and to work together cooperatively.
4. The students enjoyed the project, and it stimulated many discussions on the topics.
5. This teacher enjoyed it, too, for it gave him opportunity to know the students on other than a classroom basis.
6. This class project gave the students something of interest to discuss in the Freshman class meetings. Bills were submitted to be paid, and voted on by the class group. The project was handled very scientifically.

The paper drive helped all of us in many intangible ways, and everyone enjoyed the experience.

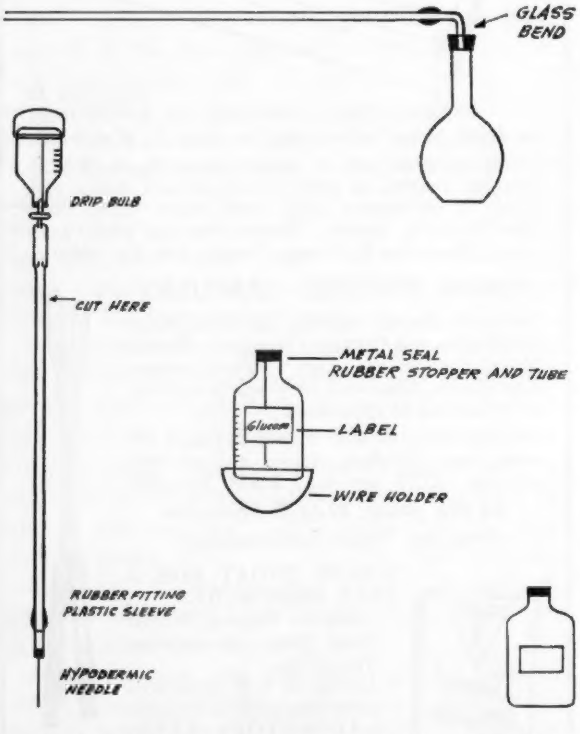
Classroom Ideas

Chemistry

Securing Free Materials

By C. W. OWENS, N. R. Crozier Techincal High School, Dallas, Texas

Free Reagent Bottles. Hospitals are willing to give to science teachers the glucose bottles used in intravenous injections. These bottles are calibrated and by removing the label, the metal band and the rubber stopper, they may be utilized as excellent reagent bottles. The neck has threads, and a screw cap the size of the neck can be easily fitted.



Plastic Delivery Tubes. The I. V. tubes which are used in intravenous injections make excellent delivery tubes. They are not as good as glass but can be used in many experiments since they are made of polyethylene plastic. By removing the bulb and the plastic tip they are useful.

General Science

Cure for Hard-to-Dry Glassware

By ROBERT G. DOTY, Canby, Oregon, High School

An apparatus for drying glassware is easily adapted for use in a high school laboratory. As shown in Figure 1, the apparatus consists basically of a pipe cap, a pipe plug, and two pieces of small pipe. Sizes are not given as they will be determined by the available supports. The modification in Figure 2, is supported on a steam boiler stand; however, a ring stand with suitable ring supports would serve well.

In use, the apparatus is supported over a heat source (bunsen burner or hot plate), and the side pipe is connected to a small compressor by a length of rubber tubing. The hot air in the center chamber is driven out the vertical pipe and will dry a test tube in less than ten seconds. Taking up very little space and allowing no clutter, it is ideal for use of laboratory students. The cost is about \$2.00, and it is more effective for drying graduated cylinders, erlenmeyer and florence flasks than the "towel-stuffing" method.

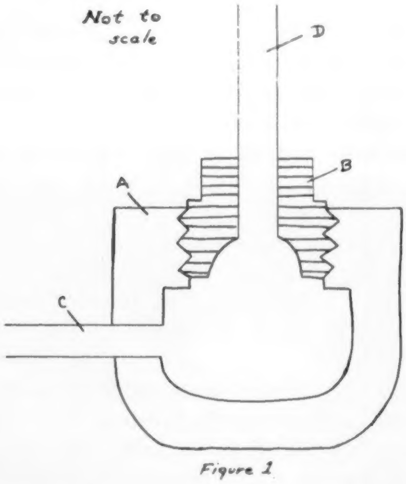


Figure 1

A is the pipe cap; B is the pipe plug; C and D are the two pipe extensions. D is about 10" long and has a hole drilled in it about 1" from the upper end. In our model, both C and D ¼" inside D.

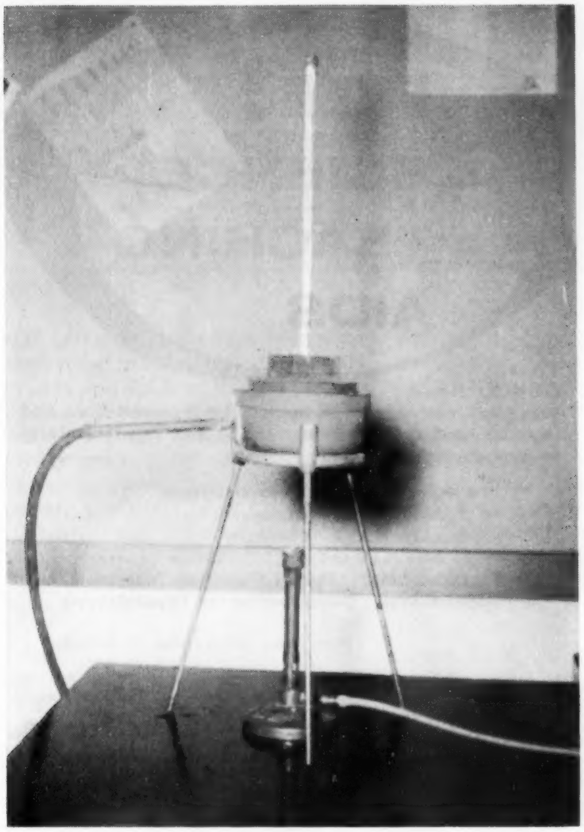


Figure 2

Completed Apparatus in Use

Physics

Demonstration Experiment on Parallel Forces

By DAVID T. SMITH, Catalina High School
Tucson, Arizona

The demonstration experiment described on parallel forces has student appeal in its element of suspense, as well as its ability to afford a clear picture of a solution to the problem of the center of gravity of a non-uniform plank. A wedge-shaped board is constructed from a two-foot scrap (2″ x 4″), and the board end is weighted by adding a shot in holes plugged by corks. The apparatus is completed by securing a screw-eye at each end and a perforated strip of sheet metal along the top. (A suitable strip can be "borrowed" from an Erector set or from a sheet metal or heating concern.) (Fig. 3.)

By Newton's third law, the force of the bat on the spring balance supporting each end is equal in magnitude and opposite in direction to the force of the balance on the bat. The total force of the bat (by gravity) then is the sum of the forces read on the spring balances at the ends, $F_1 + F_2$. This is the force (weight) acting at the center of gravity.

By considering the bat to be pivoted at one end (select say, F_1) then the sum of the clockwise torques must equal the sum of the counter clockwise torques or the bat will rotate (Newton's first law) until torques are balanced. Using this relationship then, the product of the force at the free end in dynes, by the length of the bat in centimeters will equal the product of the weight of the bat in dynes by the distance from the pivot point to the center of gravity in centimeters.

$$\frac{F_2}{(\text{dynes})} \times \frac{1}{(\text{cm})} = (F_1 + F_2) \times X \text{ (dynes/cm)}$$

Solving for X:

$$X = \frac{F_2 \times 1 \text{ (dynes/cm)}}{F_1 + F_2 \text{ (dynes)}} = \text{Cm}$$

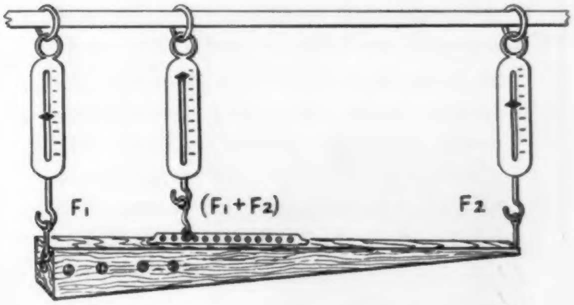
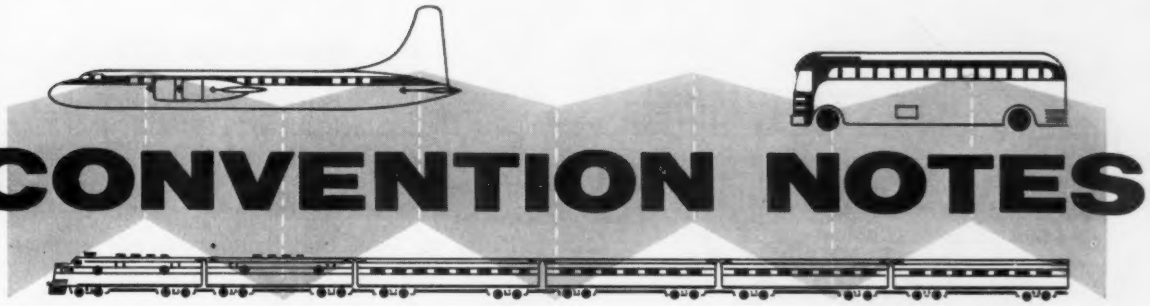


Figure 3

After setting the experiment for all this, and making the required computation of the location of the center of gravity, hook a third spring balance loosely to the perforated strap at the spot selected, and with two scissors simultaneously cut the bat from the supports at each end. Leave the bat suspended horizontally by the single spring balance, and take the reading, which has already been established by the experiment.



CONVENTION NOTES

In carrying out the theme—SCIENCE EDUCATION FOR AMERICA: AN APPRAISAL AND A LOOK AHEAD—the seventh annual convention of the National Science Teachers Association will feature programs about science education in Europe, Russia, Latin America, the Orient, and the United States. The convention will be held at the Ambassador Hotel in Atlantic City from Tuesday, March 31 through Saturday, April 4, 1959.

Six of the sessions have been developed in logical sequence so that each program will be related organically to what has preceded, and to what will follow. The first two general sessions are expected to yield a description and appraisal of science programs outside the United States. Foreign students and eminent scientists will appear.

The third general session will present American science programs from kindergarten through twelfth grade. Because of the widely varied activities in different parts of the country, it has been decided to include programs for three kinds of school categories: (1) a metropolitan system, (2) a county or suburban system, and (3) a small school system.

Areas of particular significance in American science education have been selected for intensive investigation in two series of parallel sessions. They include current efforts in curriculum redesign at all levels, working with students that have intense interest and special ability in science, working with students of limited interest and ability, summer programs for science students, reading and the science program, administrative and organizational problems, and teacher training.

The final session in the series is "The Look Ahead in American Science Education." Based on the five preceding programs in the sequence, it will suggest guideposts for further development and improvement.

In addition to the logical development of the convention theme, there will be other interesting program items. A series of six teaching demonstrations should be of particular interest to classroom teachers. These will cover primary and intermediate elementary grades, junior high general science, and senior high biology, chemistry, and physics.

The "Here's How I Do It" sessions have been scheduled for all three days of the convention. This response to popular demand will enable each convention attendant to take in all or selected parts of three different sessions. There will also be 15 to 20 Curbstone Clinic discussion groups.

With more space available for exhibits than at any previous NSTA convention, the annual Exposition of Science Teaching Aids will offer the largest array ever of new textbooks, laboratory apparatus and furniture, and other facilities.

Meetings for supervisors are being planned as an integral part of the convention program this year. Principal sessions will be held on Tuesday and Wednesday, March 31 and April 1.

Five meal functions have been scheduled during the convention. There will be a luncheon for supervisors on Tuesday, the annual luncheon sponsored by NSTA's Business-Industry Section on Thursday, and the New Jersey Science Teachers' Association luncheon on Saturday. The annual banquet will be held on Friday evening, at which time newly elected officers and regional directors will be introduced. The NSTA Life Members' breakfast is scheduled for Saturday morning.

The General Program Committee headed by Miss Helen E. Hale of the Baltimore County, Maryland Schools includes: Dr. R. Will Burnett, Professor of Science Education, University of Illinois; Mr. Robert H. Carleton, Executive Secretary, NSTA; Dr. Elmer Easton, Dean of The College of Engineering, Rutgers University; and Mrs. Florence Gardner Seward, West Orange, New Jersey High School.

Also, Dr. William H. Gregory, Special Assistant in Science, Philadelphia Public Schools; Dr. Alfred Saseen, Superintendent of Atlantic City Schools; Dr. Walter A. Thurber, Professor of Elementary Science, Cortland, New York Teachers College; Dr. Herbert A. Smith, President of NSTA, University of Kansas; and Mr. Howard B. Trombley, Caldwell, New Jersey High School.

Dr. Hugh Allen, Jr., Science Education Professor at Montclair State Teachers College, and Mr. Harry A. Young, chairman of the science department, Atlantic City High School, share responsibility as co-chairmen for local arrangements for the convention. They and their local committee are making plans to accommodate well over 2000.

Hotel reservations should be made as early as possible. Write directly to the hotel; be sure to mention the NSTA convention and give expected arrival and departure times. You can save on rates by doubling up, two or three to a room. You must make such arrangements in advance, however; neither the hotel nor NSTA can assume responsibility for making these assignments.

Miss Helen E. Hale, Chairman of the General Program Committee for the Atlantic City Convention, is supervisor of science and mathematics in the Baltimore County, Maryland Senior High Schools.

ROLLER . . . from page 250

in any activity that requires use of these tools. It means that a high school graduate who has not learned a great deal of mathematics—not *had,* but *learned*—cannot enter any of the mathematical sciences.

Fifth, we know that there is far too much to be learned to waste any time. The experimentalist, Oliver Lodge, once remarked that he would have liked to have been a theoretical physicist, but that he didn't find out about it until he was 18 years old, and of course it was then too late to start. He lacked the necessary mathematical background.

Out of all of this there emerges a picture of a way in which we can indeed use our knowledge of current science to improve science teaching.

First of all, if we are to teach science and to produce scientists, we must produce a climate of opinion that is favorable to intellectual achievements—*all* intellectual achievements. Since this means trying to change a dominant characteristic of our culture, it will not be an easy task, but one that must be performed if we want more genuine science in the United States.

Second, we can try to give our able children the intellectual tools that they will need. This means, generally speaking, less emphasis on "togetherness" and more emphasis on reading, writing, and arithmetic. Specifically, it means that those children who are to be successful in any area of intellectual work must have a well planned and comprehensive program throughout their school life. They should learn algebra in the seventh grade and elementary calculus by the end of high school; they should study at least two foreign languages for between six and twelve years each; they should read books by the carload, and write essays by the hundreds. All of this is not to make them scientists, but to make them educated so that they can pursue science.

Third, if we can indeed succeed in producing a climate favorable to intellectual activities, if we can indeed produce educated children, then we can try to teach them some science. But this then means that the teachers are going to have to *understand* science. So long as the teacher talks about

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"B G" BIOLOGY WHEEL PACKETS: William S. Green, biology teacher at North High School, Denver, Colorado, reports a number of inquiries about materials discussed in his 1957 STAR entry, "Biology Students and Critical Thinking" (*STAR Ideas in Science Teaching,* NSTA publication, $1). Mr. Green is currently making up a limited number of packets to contain a sample of the wheel, study sheets, test, and directions for use. He plans to supply these to teachers at a nominal cost. Write to: William S. Green, 1133 Hudson Street, Denver 20, Colorado.

"laws of nature" instead of calling those so-called laws what they are, namely, hypotheses whose truth cannot be established in any absolute sense; so long as he tells the class that electrons are things instead of explaining that they are concepts; so long as each generation of Americans thinks that science is carried on only or even mainly in the laboratory, whereas most of it is actually carried on in the head, we cannot produce an appreciably large number of good scientists.

Now the nature of facts, concepts, and theories is difficult to teach and difficult to understand. Children, like adults, find it easier to deal with the concrete than with the abstract, easier to study things than ideas. Perhaps children cannot deal with such a complicated area of learning as science. I am a college teacher and I am not even a teacher of education. Perhaps, through ignorance, I underestimate the difficulties of teaching children. As a matter of fact, I am sure that I know comparatively little about the subject. Nonetheless I believe that many of us seriously underestimate the ability of children to handle complicated and abstract ideas. My long-standing feeling on this matter was confirmed by some experiences during this present academic year, during which I have been teaching sixth graders on an experimental basis. The students in this class run the whole spectrum of abilities, but include several very bright ones. What I am trying to do is to teach them science—not about sewing machines and typewriters; not what the atomic weight of chlorine is on a basis of our present hypotheses, but what the hypotheses are, where they came from, and to what extent they are valid; not how high a Sputnik is, but how to calculate why we believe it is that high on a basis of astronomical theory; not that electricity runs along a wire, but why it is useful to assume that it does; not that Benjamin Franklin flew a kite, but that what he did in his head was terribly important.

Not being limited by any predetermined curriculum, I range where I please in this teaching. These eleven and twelve-year-old youngsters are able to attack such a sophisticated question as "How do we know the earth is round?" and come up with the right answer, namely, that we do not. And the most striking thing about this experience is that I find it difficult to reach a level of sophistication where at least a few of these children cannot follow me.

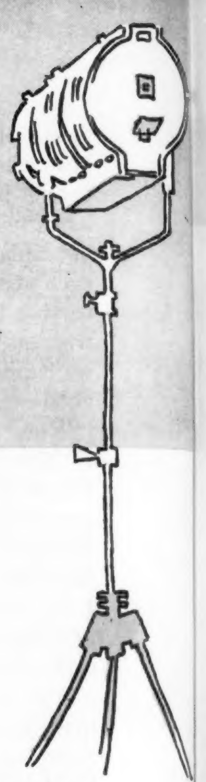
In discussing the importance of clearly defining the terms one uses, I must do so with the anticipation that they will nail me within a few minutes for hinging one of my arguments on an undefined term. If I chide one of them for using a circular argument in defining a term, it is with the knowledge that one of them will shortly thereafter catch me in a circle from which I can not escape.

In brief, on a basis of this limited experience, I can not accept the premise that anything is too sophisticated to be taught to children, at least of this age. But the teacher is going to have to know the subject matter well, and is going to have to have the facility to say "I don't know" or else live a life approaching utter frustration.

Finally, if we really want to produce scientists, we must try to seduce that bright and imaginative young dreamer in the back row away from some other intellectual career. We must get his nose on the grindstone; and if he won't keep it there, devote your energy to some more promising recruit.

If you can convince him that, despite the TV advertisements, it is not science that is proving which cigarette does the least damage, not science that is designing longer and wider automobiles, or designing rockets; if you can convince him that working fifteen hours a day can be more fun than anything else, that man as a species is a tool-making animal, but that only a very few of the species have the privilege of seeking to understand: then you may very likely help produce a scientist. At least you will not be preventing him from becoming one.

SPOTLIGHT on RESEARCH



The Educational Film in The Teaching of Science

By HERBERT A. SMITH

University of Kansas, Lawrence

TEACHERS are indispensable! Of course; teachers have always known this but with growing emphasis on education by television, it is perhaps a significant time to look at the classroom teacher's role in the use of audio-visual aids. Some of the most extensive research on any visual aid has pertained to educational films. The results are conclusive in terms of assigning an extremely important role to the teacher.

What are some of the findings of research on the use of films which have important implications for the classroom? There are a relatively large number of research studies which relate to some aspect of educational films, but perhaps the most significant findings relate to the manner of film use. Studies by Wise, Wahl, and Miller;[1] and by Anderson, Montgomery, and Smith;[2] as well as many others, have all underlined the importance of this factor. An inescapable conclusion is, apparently, that the manner of use determines to a considerable extent the outcomes that one may expect.

If the foregoing conclusion is correct, and it seems firmly established, the implications for teachers using this aid are many. It means that teachers will not present films that they have not previewed to their classes. How can one know the contribution to be made by an unknown aid? Obviously, the quality and appropriateness of films vary.

Sound instructional procedures require that there should be purposes and goals for every instructional activity carried on in the classroom. The educational film is no exception. What unique contributions does it make? How does it fit into the present instructional picture? Is it the best way to introduce or to summarize a unit; or does it present an abstract idea or difficult concept in the most effective way? Does it bring to the classroom experiences otherwise unavailable? These are questions that the teacher should and must face. Meierhenry's [3] and many other studies have substantiated that the contributions of educational films to learning are real and lasting, but best results are clearly obtained when both teachers and students understand where they are going and why.

The film should be integrated into the total instructional plan and purposes for viewing should be established with the students prior to actual showing of the film. Keeslar [4] has shown that films tend to emphasize the informational aspects of science. However, the skillful teacher may use the film in such a way that more illusive and intangible objectives may be realized. The same film may contribute to many different instructional objectives, depending largely on the particular orientation of students established prior to the showing.

Following the showing of the film, successful procedure seems to indicate a discussion period

[1] Miller, Paul F.; Wahl, Edwin E.; and Wise, Harold E. *An Evaluation of the Effects of Using a Planned Introduction with Sound Motion Pictures in General Science Classes.* Lincoln: University of Nebraska Press, 1946.

[2] Anderson, Kenneth E.; Montgomery, Fred; and Smith, Herbert A. "Toward A More Effective Use of Sound Motion Pictures in High School Biology." *Science Teacher* 40: 43-45; February 1956.

[3] Meierhenry, Wesley C. *Enriching the Curriculum Through Motion Pictures.* University of Nebraska Press, 1952.

[4] Keeslar, Oreon. "Contribution of Instructional Films to the Teaching of High School Science." *Science Education,* 30: 82-88; March, 1946; 30: 132-136; April 1946.

focused on the particular learnings expected. Later evaluation procedures should include evaluation of the learning expected to be derived from the films used.

Careful use of films in the manner indicated above tends to stress the viewing of films as an educational experience, and as a normal part of the instructional process rather than as an isolated interlude or entertainment.

The presentation to this point tends to place a heavy emphasis on film selection. Obviously, films should be used only when they contribute efficiently to course objectives. This would eliminate many of the films presently shown in classrooms. Films shown for general effect seem to have no educational consequence of note. The use of free films provided on an unpredictable basis has very doubtful values. In the use of films, as in so many other instances, one seems to get what he pays for both "educationally" and financially.

In a series of studies, Smith [5, 6, 7], seems to have established that films are effective teaching instruments for students representing all levels of the intellectual spectrum. It is a fallacious argument that bright students do not profit materially from the use of these aids. As one might expect from any learning situation, they profit more from films properly used than do other students. Films seem to be useful with students at all ages.

By virtue of their training, science teachers have tended to be interested in audio-visual aids of all kinds. A considerable portion of the research on educational films has been conducted by active or former science teachers. No doubt many of the problems besetting the effective use of films will be eventually resolved by aggressive, research-minded science teachers.

Those engaged in research or who wish to keep well informed and abreast of developments in this field will find of special interest the NEA Department of Audio-Visual Instruction research quarterly, *The Audio-Visual Communication Review*. It includes summaries and analyses of outstanding research in A-V communication and related fields.

To summarize, the research evidence available seems to indicate that films are extremely valuable teaching aids when properly used. Nevertheless, there remain serious problems and a coordinated attack ought to be made to provide answers to such thorny questions as the following:

1. How can the administrative machinery provide the right film at the right time in the specific classroom where it is needed?
2. How can time and equipment be made available to the busy teacher to permit a preview of the film so that effective planning for its use is a reality?
3. How can teachers be convinced that the great potential of this powerful aid can only be realized when films are carefully selected, thoughtfully previewed, carefully introduced, and thoroughly discussed and evaluated?
4. How can films be used to contribute to such higher level objectives as attitude formation and problem-solving skills?
5. How can the quality of films produced be improved?

Educational films are used every day. Millions of dollars are spent on their production, transportation, and rental. They are an important aspect of the educational scene. This is some measure of their educational significance. But we end where we began; the teacher is indispensable!

NSTA Committee on Research

Beginning with this issue, a new feature series will be reported in TST by NSTA's Committee on Research. The series will include summaries and interpretations of research findings which relate to various aspects of science teaching. The material will be presented in a non-technical style intended to assist the classroom teacher in translating research findings into practical applications.

During 1958-9, the articles will be prepared under the direction of the committee's chairman, Dr. William B. Reiner, Bureau of Educational Research and Statistics, Board of Education, City of New York. Author credit will be given for each article in the series. Readers of TST are invited to send in comments or questions relating to the reported topics, or suggestions for future articles by writing directly to Dr. Reiner. *Committee members:* Dr. Kenneth Anderson, University of Kansas, Lawrence; Dr. Sam S. Blanc, Gove Junior High School, Denver, Colorado; Dr. Clarence Boeck, University of Minnesota, Minneapolis; Dr. Merle E. Brooks, Kansas State Teachers College, Emporia; Dr. George Mallinson, Western Michigan University, Kalamazoo.

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[5] Smith, Herbert A. "Intelligence as a Factor in the Learning which Results from the Use of Educational Sound Motion Pictures." *Journal of Educational Research*, 46: 249-61; December 1952.

[6] Smith, Herbert A. Chapter 9, "Motion Pictures, Intelligence, and Enrichment." *Enriching the Curriculum Through Motion Pictures.* (Edited by Dr. Wesley C. Meierhenry.) University of Nebraska Press, 1952.

[7] Smith, Herbert A. "Qualitative Aspects of Gain on Final Over Initial Measures in Achievement Testing." *Audio-Visual Communication Review*, 1: 167-174; Summer, 1953.

SCHAEFER . . . from page 271

teachers trained only in physics or chemistry, may have already driven many promising potential research biologists out of the field by their own expressed lack of respect. Perhaps much the same thing has happened regarding the teaching of sciences as regards outstanding potential teachers of science, but possibly with more justification in the last decade.

The final requirement of the course is a comprehensive report on the research activity of the students, and their evaluation of the course. It is suggested that after these students have pursued their further study for two or three years, that a further evaluation is made of their progress to determine if the plan or course were helpful, and how they would suggest altering either the method or the content of the courses.

It is the sincere hope of this writer that the course offered this group of outstanding students will be of use to them whether they follow a study of physics, chemistry, biology, or mathematics; and, that some of the potential rough spots in their future study will have been smoothed just a little. It is also hoped that in the future, all members admitted to this class will have taken *both* chemistry and physics before their senior year so a little more balance may be thrown in the direction of physics and a little less in the direction of chemistry.

Next year, general science is being removed from the high school curriculum and the program in science in the grades is being strengthened accordingly. Biology is being offered to those students with the capability and interest necessary on the ninth-grade level, and chemistry will be offered to this group—or others with equivalent aptitudes—at the tenth-grade level. This makes physics available in the eleventh grade and advanced science for those meeting specifications, in the twelfth. A course in physical science is being added to the curriculum for those students who are most probably terminal in science. With the requirement that each student have two years of science for graduation, it is hoped that in addition to providing for the gifted student, *each* student will be exposed to both biological and physical science of some kind before graduating. In this way, chemistry and physics can retain their quantitative characteristics; and those who do not need the quantitative parts can still take part in the science program. The physical science course serves this purpose, as well as that of a science course, for students whose primary interest is in an area other than science, and have outstanding academic aptitude. In the opinion of the writer, this is a much more realistic approach than the trend of lowering the level of the chemistry and physics courses in the attempt to make them all-purpose—a trend which will certainly be reversed at least somewhat by "Sputnik-ism". This aproach may have been a boon to the average and below average student, or to the students looking for the easy way out; but it was certainly a disservice to the gifted student. Yet, it is probably this student who has the greatest need for a good background and who will do the greatest service for mankind through his work in science. This should be especially true if a tolerance for the other facets of scientific study is developed, and the limitations of science understood along with its potentialities.

As a regular feature of *The Science Teacher*, the calendar will list meetings or events of interest to science teachers which are national or regional in scope. Send your dates to *TST's* calendar editor. Space limitations prevent listings of state and local meetings.

September 7-12, 1958: 134th National Meeting, American Chemical Society, Chicago, Illinois

October 1958: National Science Youth Month

October 17-18, 1958: NSTA Southeast Regional Meeting, Nashville, Tennessee

October 17-18, 1958: NSTA Southwest Regional Meeting, Pasadena, California

October 26-28, 1958: SAMA Laboratory Apparatus and Optical Sections of Chicago, Midyear Meeting at Rye, New York

November 9-15, 1958: American Education Week

November 27-29, 1958: 58th Convention, Central Association of Science and Mathematics Teachers, Indianapolis, Indiana

December 27-30, 1958: NSTA Annual Winter Meeting with science teaching societies affiliated with the American Association for the Advancement of Science, Washington, D. C.

February 19-21, 1959: National Association for Research in Science Teaching, Atlantic City, New Jersey

March 31-April 4, 1959: NSTA Seventh National Convention, Atlantic City, New Jersey

SCIENCE TEACHING MATERIALS

NSTA Teaching Materials Review Committee

NSTA and Northern Illinois University are cooperating in a joint project which will include reviews and reports on teaching materials used in elementary and secondary school science programs. The materials will include books, films and filmstrips, tape recordings, charts, laboratory apparatus, selected reading references, and related items. After review, the materials will be retained in appropriate depositories of the Northern Illinois University for use by students, faculty, or visiting educational groups. Dr. Robert A. Bullington, Department of Biological Sciences, Northern Illinois University, Dekalb, Illinois, will direct the project as chairman and be assisted by committee members: Loren T. Caldwell, Harvey A. Feyerherm, and Allen D. Weaver, of the NIU; Walter E. Hauswald, Sycamore High School, Illinois; and Robert L. Smith of Dekalb High School.

NSTA will refer related inquiries to the Review Committee, and readers are encouraged to send correspondence or materials, as described above, directly to the chairman of the committee. Suppliers and publishers of science teaching materials are requested also to send items for review and examination to Robert A. Bullington at Dekalb, Illinois.

BOOK BRIEFS

THE MYSTERIOUS UNIVERSE. Sir James Jeans. 187p. $1.35. Dutton and Company, New York. 1958.

Paperback edition of a book, originally published in 1930, which has become a classic of science writing for the lay reader. Sir James writes philosophically and with clarity on matter, relativity, space, and a variety of other topics.

DARWIN'S CENTURY. Loren Eiseley. 378p. $3.00 Doubleday, Garden City, New York. 1958.

This book presents in retrospect the relations between the thoughts and lives of Darwin and Wallace, Lyell, Lamarck, and other evolutionists, and pre-evolutionists, as indicated by the subtitle, "Evolution and the Men Who Discovered It." It is timely and significant in this year of the centennial anniversary of Darwin's publication, "The Origin of Species."

THE PHYSIOLOGY OF MAN. Second Edition. L. L. Langley and E. Cheraskin. 674p. $6.95. McGraw-Hill Book Company, New York. 1958.

Covers the nervous, circulatory, respiratory, alimentary, excretory, and endocrine systems of the body, beginning with a modern interpretation of the functions of the cell. In spite of this systematic treatment, the body is considered as a whole. Illustrated by drawings and photographs.

WALTER REED, THE BOY WHO WANTED TO KNOW. Helen Boyd Higgins. 192p. $1.52. Bobbs-Merrill Company. Indianapolis. 1958.

Designed for grades 4-8, this book is one of approximately 100 volumes of "The Childhood of Famous Americans Series," fifteen of which deal with famous scientists. The author has portrayed the life of Walter Reed from boyhood to his profession as a doctor.

EXPERIENCES WITH LIVING THINGS. Arnold G. Applegarth and Matthew F. Vessell. 192p. $3.50. Fearon Publishers. San Francisco. 1957.

This publication is a guide to the common western plants and animals It is useful for science teachers, and also scout leaders, camp counselors, and interested laymen. The first of the three divisions deals with preparation for, procedures during, and evaluation of eight well-chosen field trips. The second includes lessons built around materials collected during the trips. In the third, twelve simple keys for the more common plants and animals are given. Although covering mostly western species, the material is treated in such a manner that it is also of value to biology teachers.

NATURAL SCIENCE, Books 1 and 2. Revised Edition. Each 64p. $1.35. The Educational Publishing Corporation. Darien, Connecticut. 1958.

For the elementary classroom teacher and science supervisor, these books contain lessons in science written by classroom teachers and science education specialists.

Book 1 has 37 lessons, units, and projects covering seeds, flowers, leaves, trees, birds, and soil.

Book 2 has 36 lessons on fish, turtles, frogs, mammals, and insects, with illustrations.

WEBSTER CLASSROOM SCIENCE LIBRARY. Kay Ware and Lucille Sutherland. Set of 12 books. Each 32p. $4.92 per set. Webster Publishing Company, St. Louis, Missouri. 1957.

Covers the subjects of insects, birds, fishes, rocks and minerals, stars, sea shells, butterflies, prehistoric animals, flowers, reptiles and amphibians, trees, and mountains and volcanoes. Designed for science reference reading for upper elementary grades.

READING THE LANDSCAPE. May Theilgaard Watts. 230p. $4.75. The Macmillan Company, New York. 1957.

The well-known and highly capable naturalist Mrs. Watts, of the Morton Arboretum at Lisle, Illinois, has produced a delightful book based upon her personal experience. The text of many chapters has been perfected in classroom and public lecture. The book covers objects everyone has seen, but possibly has not understood—fence rows, islands moving downstream, quaking bogs, canyons, forests, sand dunes, mountains, tree rings, and styles in landscaping. There is fast movement, careful organization, scientific accuracy. Descriptions are based upon unusual discernment of things commonly overlooked.

PROFESSIONAL READING

"Making Lantern Slides for Immediate Projection." By James Rosenfield. *Journal of Chemical Education* 35:314; June 1958. Describes a new photographic system that permits the snapping of a picture and its projection on a screen a few minutes later.

"The Solubility Curve of Borax: A Student Laboratory Experiment." By Robert D. Eddy, Tufts University, Medford, Mass. *Journal of Chemical Education* 35:364; July 1958. Describes a laboratory experiment in titration in which students prepare a solution and standardize it against a primary standard, or compare an unknown acid or base with a given standard.

"Materials for Teaching Conservation and Resource-Use." National Association of Biology Teachers. 55p. 35¢. Interstate Printers and Publishers, Inc., Danville, Ill. (Reprint of appendix of *The Handbook for Teaching Conservation and Resource-Use,* January 1958.) The appendix is available as a separate bulletin which includes listings of free and inexpensive materials from state and national agencies, selected references, films and filmstrips.

"Public Exposure to Ionizing Radiations." 55p. Single copies $1.35 each; discounts for 25 or more. American Public Health Association, Inc., 1790 Broadway, New York 19. 1958. Emphasizes basic concepts of the physical and biological phenomena having implications for public health.

"A Guide for Evaluating Your Science Facilities." Single copies free on request. Scientific Apparatus Makers Association. 20 N. Wacker Drive, Chicago 6. 1958. A 16-page SAMA brochure, written as a public information service for schools in cooperation with the School Facilities Council, refers to the planning and construction of science classrooms and facilities.

(*Continued on page* 296)

Book Reviews

TEACHING HIGH SCHOOL SCIENCE. Paul F. Brandwein, Fletcher G. Watson, and Paul E. Blackwood. 568p. $6.50. Harcourt, Brace and Company, New York. 1958.

Three specialists in science education have pooled their experience to produce a book of methods that both new and experienced teachers of science will find invaluable. The text contains a wealth of guiding principles and resource materials to aid in understanding the present concerns about science teaching, and serve as a guide in meeting the problems.

The book begins with a discussion of what the scientist does and the methods he uses, and then it develops classroom procedures for "teaching the ways of science." The approach gives the reader a perception for science before he is introduced to the problem of developing a similar perception in students.

Section Two includes "patterns in teaching science." The chapters describe methods of organizing science programs, differences in teachers, and procedures for working with students. Detailed attention is given to teaching students who are either science prone or science shy. The bases for developing statements of objectives for science teaching are described, as well as learning activities essential to their realization. The authors avoid prescribing a specific list of objectives for science teaching. They feel "objectives are personal, are based on knowledge of the special teaching situation, and should have the flavor of personal thought and statement."

In the third section, problems associated with building the science curriculum are critically examined. Separate chapters are devoted to a consideration of elementary science, biology, chemistry, physics, general science, and physical science. The evolution of the present science curriculum is reviewed as a basis for interpreting the present trends in (a) curriculum reorganization, (b) course development, and (c) teaching activities. The science teacher who carefully studies this section will have knowledge of the job-to-be-done and how-to-go-about-it for developing or modifying his own courses.

A sixty-page section of the text is devoted to "determining the success of science teaching." Detailed procedures for evaluating objectives are given. Aspects of test-making by the teacher are described and illustrated, and also the equally important problem of interpreting test results is considered.

Section Five consists of eighteen short chapters about the "tools for science teaching." Among those discussed are laboratory experiments, class demonstrations, projects, textbooks, workbooks, student reports, science clubs, projected and display techniques. Chapters are also given over to science facilities and equipment, the professional library, and to sources of help in obtaining teaching materials.

The book concludes with a section on the activities of three communities in their efforts to improve the teaching of science.

Throughout the text considerable attention is given to the professional growth and development of the science teacher. The importance of the teacher in defining effective teaching techniques, practices, and programs is continually stressed.

The references and bibliographies cited have been carefully selected, they are up-to-date and pertinent to the discussions.

PAUL DEH. HURD
School of Education
Stanford University, California

ELEMENTARY SCHOOL SCIENCE AND HOW TO TEACH IT. Glenn O. Blough, Julius Schwartz, and Albert J. Huggett. 608p. $6.50. Dryden Press, New York. 1958.

The new edition of this book is divided into two main sections: (1) General information about teaching elementary science for the elementary teacher; and (2) Subject matter background, with suggestions for teaching.

The first section of the book describes the status and objectives of elementary science, activities that help children learn science, the science program, and problems of teaching. The second section contains science subject matter about the main topics of the earth and the universe, living things, and matter-energy. Each topic is divided into several chapters of science content with chapters on suggestions for teaching. The last section of the book is a bibliography for each of the major sections of the book.

An elementary teacher is interested in finding a book that will help answer children's questions about recent developments in science. This book contains material about such current topics as man-made satellites, atomic energy, solar heating, jets, rockets, and radioisotopes.

An elementary teacher is also interested in finding a book that contains activities children can do to help them develop concepts. Each chapter on teaching science is a series of activities for children. Examples of these activities include experimenting, observing, studying, making things, reading, planning, and examining.

An elementary teacher is also interested in a book that contains suggestions for supplementary material and source material for teachers. This book has this kind of bibliography for each major section.

The book is illustrated with diagrams, pictures, and charts in relation to some of the major concepts presented and some of the children's activities described.

In-service teachers and pre-service teachers will find this a valuable textbook to prepare them for teaching, and a good reference book. The authors have achieved a clear, simple style of writing for the non-specialist in science. The revised edition is up-to-date, and expanded in content, yet retains the best features of the former edition. This book is a distinct and useful contribution to the professional literature of elementary science.

DONALD G. DECKER
Director of Instruction
Colorado State College, Greeley

Are you still looking for the key?

If you are still looking for the key to an exciting and informative biology course for your high school students, why not try BIOLOGY—A BASIC SCIENCE, by Heiss and Lape. This entirely new text, published this Spring, presents a dynamic and meaningful treatment of biology. It uses the problem approach to give your students ample opportunity to engage in absorbing activities. Built around eighty-five carefully selected problems, the text includes many learning experiences that are true controlled experiments.

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NSTA Activities

Regional Meetings

Two 1958 NSTA fall regional conferences 2,000 miles apart are scheduled for October 17-18, one in Pasadena, California and the other in Nashville, Tennessee. Both conferences will offer various program items that classroom teachers most often request—sessions on curricular and instructional problems in elementary science, junior high general science, and high school biology, chemistry, and physics; reports by scientists on recent developments in research and development; and "Here's How I Do It" sessions on demonstrations and other techniques for teaching.

Printed programs will be mailed in advance to NSTA members and other science teachers *within the regional scope of the conferences.* Others interested to obtain a copy should write requests to NSTA headquarters.

The Pasadena conference planning committee is headed by Mrs. Archie M. Owen, Supervisor of Science, Los Angeles Public Schools; co-sponsors of the conference are the California Science Teachers Association, Southern Section and the California Elementary School Science Association, Southern Section. The Nashville conference is being planned with cooperation of Vanderbilt University, Peabody College, and Fisk University. Planning chairman is Dr. Robert T. Lagemann, chairman of Vanderbilt's department of physics and astronomy, and treasurer of NSTA.

NSTA Staff Changes

Members will be interested in the growth, organization, and changes of personnel in NSTA headquarters staff. As of September 1, our department numbers 15 persons (sixth largest among 17 NEA departments with headquarters at famous "1201 Sixteenth Street, N. W., Washington 6, D. C."). We are now organized into four sections: membership services; professional relations; publications; and program, budget, and personnel. (Organization and job description chart available to interested members on request.)

Heading membership services is Mr. Glenn E. Warneking, who has been promoted to Assistant Executive Secretary. He had served two years as Executive Assistant.

A new position this year is Assistant Secretary for Professional Relations, and appointed to this new post is Miss Margaret J. McKibben (Ph.D., University of Pittsburgh). A teacher of biology in Oak Park and River Forest, Illinois High School for six years, Miss McKibben previously taught at the University of Pittsburgh and State Teachers College, Towson, Maryland. She was an exchange teacher in London, England during 1956-57. Miss McKibben's responsibilities include serving as co-editor of the *Elementary School Science Bulletin,* which was handled by "remote control" during 1957-58 by Dr. Dorothy Alfke of Pennsylvania State University.

Also new to NSTA and in a recently created position is Miss Frances J. Laner as Director of Publications. Her duties will include those handled during 1956-58 by Miss Jerry Askwith as Managing Editor. With majors in physics and mathematics at Catholic University, Miss Laner also has a degree in journalism from George Washington University. Although born in Colorado, she resided longer in Oregon (her adopted state), and has been in Washington, D. C., about 15 years where she served in publications work with the U. S. Weather Bureau and the Atomic Energy Commission.

Other staff promotions are: Mrs. Kent Godwin to Administrative Assistant, succeeding Mrs. Mary Batiste Murchison (resigned for maternity—a son, Scott); Miss Marilyn Suthard to succeed Miss Barbara Morse as Secretary to Mr. Carleton; and Mrs. Alicia G. McKelvie from Secretary to Editorial Assistant.

Miss Edith Nicholas also has joined the NSTA staff as Membership Secretary, succeeding Miss Louise Lyons who served the Association in this capacity during 1956-58 after her retirement as chemistry teacher in Steubenville, Ohio High School. Other members of the staff include: Thelma Ruth Wargo, Marcia Felter, Noli Evangelista, Judy Kuhn, and Gail V. Leggett.

1958 Board Meeting

The 1958 business meeting of the NSTA Board of Directors was held June 25-26 at Hotel Deshler-Hilton, Columbus, Ohio. Action highlights include:

1. Acceptance of, and action on reports of about 30 NSTA committees.

2. Discussion and action based on annual report of the Executive Secretary.

3. Discussion of Treasurer's report for 1957-58.

4. Adoption of codified statement of policies adopted by NSTA Boards of Directors during 1944-58.

5. Approval for a conference on the secondary school science curriculum (grades 7-12) as a follow-up of the conference on elementary school science held May 22-24, and sponsored by the National Science Foundation.

6. Adoption of program for 1958-59, accompanied by a budget of $341,000 (of which about $96,000 is expected to be derived from payment of membership dues).

7. Induction of NSTA President for 1958-59, Herbert A. Smith, University of Kansas, Lawrence. Dr. Smith will be on half-time leave from his teaching responsibilities during his year in office.

The meeting was exceptionally well attended with 18 board members representing all eight regions of the Association.

Available to NSTA members on request are copies of the Executive Secretary's report, the Treasurer's report, and the budget for 1958-59.

B-I Section Officers

The only Section of NSTA is that for business-industry members, operating under its own set of By-laws to our constitution and an Executive Committee elected at B-I's annual meeting, held as part of the NSTA convention each year. Elected at Denver to serve during 1958-59 were:

Chairman—Mr. Julian Street, Jr.; *Staff Director,* Educational Aids and Technical Public Relations; U. S. Steel Corporation; New York, N. Y.

Secretary—Mrs. Thelma T. Scrivens; *Assistant to the Director,* Educational Department; Hill and Knowlton, Inc.; New York, N. Y.

Treasurer—Mr. Owen O. Hunsaker; School and College Service, United Air Lines; New York, N. Y.

Members-at-large—Mr. John McGill; Public Relations; American Trucking Associations, Inc.; Washington, D. C.

Dr. George R. Seidel; *Eastern District Manager,* Extension Division, E. I. duPont de Nemours and Company, Inc.; Wilmington, Delaware.

Dr. Robert C. Lusk; *Director,* Educational Services; Automobile Manufacturers Association; Detroit, Michigan.

JULIAN STREET, JR., Staff Director, Educational Aids and Technical Public Relations for the United States Steel Corporation, has directed the educational program for schools and colleges since 1952. A graduate of Princeton University (A.B., cum laude in English) in 1925, he has served nine years in government in information and public relations activities. His positions included those of consultant for the War Bond campaign to the Secretary of the Treasury; information officer with UNESCO, Department of State, and also with the Economic Cooperative Administration in Paris; and previously eleven years in public relations activities with the National Broadcasting Company.

FSA Activities

1958-59 Program

Recommended by the Administrative Committee and approved by NSTA's Board of Directors, following are the program elements for which an FSAF budget of $105,000 is being sought this year.

1.	Registry of science teachers (expansion to 50,000)	$ 3,500
2.	*Careers in Science Teaching* (revision, 30,000 initial printing)	3,500
3.	*Keys to Careers* (revision, 30,000 initial printing)	3,500
4.	Support of NSTA Commission on Education in the Basic Sciences	5,000
5.	*How Science Teachers Can Help The Honor Student* (new booklet)	2,500
6.	Support of *Tomorrow's Scientists*	3,500
7.	On-the-Job Research	10,000
8.	*Ideas for Student Science Projects* (revision)	1,500
9.	*If you Want to Do a Science Project* (revision)	500
10.	*If You Want to Have a Science Fair* (new booklet)	1,500
11.	*If You Want to Organize a Science Club* (new booklet)	1,500
12.	Administrative Committee meetings, promotion	5,000
13.	Contingencies	2,500
	Basic Program	$44,000
	Administrative service charge	11,000
	Total general grants	$55,000
14.	American Society for Metals Science Achievement Awards	20,000
15.	Summer Conferences for Science Teachers	30,000
	Grand Total	$105,000

On-the-Job Research Grants

The Administrative Committee of NSTA's Future Scientists of America Foundation, after a pilot run of the idea, has developed an excellent program of research grants for secondary school science teachers during 1958-59. Grants ranging up to perhaps $1000 will be made available to interested and qualified teachers of any of the sciences in junior or senior high schools, public and private. The committee which will review research proposals and make grants for On-the-Job research will meet on October 31 and all applications for such grants should be sent to the Executive Secretary of NSTA not later than October 25.

The FSAF Committee believes that opportunities to do research, both in the sciences and in the teaching of science, should be available to science teachers in secondary schools during the school year as well as during summer. Research activity can bring the teacher into a sound closer association with the scientific community at large. Research opportunities can make teaching more attractive to the kind of people who are needed to instruct and inspire youth. Above all, research activity can enliven teaching, give students early exposure to a research environment, and give interested and able students a chance to participate in original investigation.

The research problem should offer promise of making a significant contribution to knowledge. It must be practicable within the limits of time and facilities imposed by the teacher's activities. It should be related in some way to the teacher's work as a teacher. It should be planned and conducted in consultation with an active investigator in the given field. The consultant will usually be a member of a college or university faculty or a member of the staff of a research institution, industrial laboratory, or government research facility. The teacher should be able to obtain his advice and help during the project.

The teacher should obtain approval from his supervisors, particularly of plans to use school space and facilities, either during the school day or after hours, plans to involve students, and arrangements for receiving and disbursing funds.

For further information and instructions on how to apply please write to the Executive Secretary at NSTA Headquarters.

FSAF Sponsors

These business-industry organizations have made financial contributions to FSAF since the roster of additional sponsors was prepared for the May issue of *TST*.

The Alcoa Foundation
American Cyanamid Company
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The Merck Company Foundation
The Perkin-Elmer Corporation
Philco Corporation
The Proctor & Gamble Company
Royal McBee Corporation
Standard Oil Foundation, Inc. (Indiana)
Stauffer Chemical Company
United States Steel Corporation

SAA Program

Calling all science teachers to the eighth annual program of Science Achievement Awards for students!

With increased financial support of the American Society for Metals, the program is being expanded this year; Regions II, V, and VIII are being divided into two districts each with new, equal numbers of awards as in other regions. In all, there will be 198 regional awards and 22 national awards—total value about $14,000. Information and student entry forms will be available from FSAF about October 1. Help your students get started on suitable science projects which they can carry through and report by next March 15.

Professional Reading . . . from p. 288

"A Comparative Study of Gifted and Average High School Graduates of Atchison, Kansas." By Charles W. Lafferty. *Bulletin of Education* 12: 82-85; University of Kansas. May 1958. The study gives comparisons between two groups of high school graduates, with statistical data.

"Improving College Biology Teaching." Publication 505. National Academy of Sciences-National Research Council. 1957. A report on biological education and how to improve the teaching of the biological sciences.

"The Status of Secondary Science Education in the State of Ohio." By Charles L. Koelsche, University of Toledo, Research Foundation, Toledo. 1958. A 29-page booklet which points out a number of problems in the high schools and recommends some remedies.

"Analysis of Research in the Teaching of Science. July 1955-July 1956." By Ellsworth S. Obourn. Bulletin 1958, No. 7, U. S. Department of Health, Education and Welfare, Washington, D. C. 1958. A 50-page bulletin with bibliography gives an annual summary of research in the teaching of science.

"Analysis of Research in the Teaching of Mathematics, 1955 and 1956." By Kenneth E. Brown. Bulletin 1958, No. 4, U. S. Department of Health, Education and Welfare, Washington, D. C. 1958. A 27-page bulletin with Summary of Research Studies as an appendix, in which a report is given of the findings in the research on mathematics teaching.

"Science and Foreign Policy." No. 130. 62p. Single copies 35¢. Discount orders on request. Headline Series, Foreign Policy Association, 345 East 46th St., New York 17. July-August 1958. An informative series giving analyses on current problems related to foreign policy and science, and related topics.

APPARATUS AND EQUIPMENT

Torso. A recently developed model (AM97): torso with head, of molded vinyl plastic, nine removable parts, and simplified for use where great detail is not necessary. Very adequate for high school use. Model is also supplied with separate plaques of vertebra and male and female genital organs. $294.50. A. J. Nystrom and Co., Chicago 18.

Wind Meter. Handy pocket wind gauge that registers wind velocities up to 60 mph. Useful to the teacher who carries on outdoor activities. $4.95. F. W. Dyer Manufacturing Co., Box 373, Michigan City, Ind.

Sky Globe. The Sky Master Kit provides the materials for assembly of a 12-inch globe which shows the sky as we see it. The globe shows all naked-eye stars (Magnitude 5½), important nebulae, Milky Way and the ecliptic, the ecliptic and galactic poles, and other data. Star and constellation names are printed. Globe Kit $3.50, guide and check lists in book form, $1.50. Sky Master, 781 Farview Ave., Fairview, N. J.

Water Treatment Plant Kit. Designed for upper elementary and junior high school science, this kit makes possible the construction of a complete typical water purification plant. Easily set up and operated by the students, the plant will permit real experimentation in water treatment processes. $79.95. Product Design Co., 2796 Middlefield Road, Redwood City, Calif.

Radiation Detection Kit. A Geiger Counter that can be assembled in three hours or more by students with simple tools. No soldering required. Works effectively in the laboratory and can be used in the field, if handled with care. Packed in cardboard box. Includes earphone, radioactive ore, and 48-page manual of experiments with radioactivity. $18.50. The Library of Science, 59 Fourth Ave., New York 3, N. Y.

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